MASSACHUSETTS BAY TRANSPORTATION AUTHORITY

MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

south west corridor

ENVIRONMENTAL IMPACT ANALYSIS

FOR THE PROPOSED: ORANGE LINE RELOCATION, and ARTERIAL STREET

This Environmental Impact Analysis was prepared under the direction and with the active involvement of Urban Mass Transportation Administration, the Federal Highway Administration, Massachusetts Bay Transportation Authority, the Massachusetts Department of Public Works, the Central Transportation Planning Staff and by the staff of Frederic R. Harris, Inc., Consulting Engineers, Boston.

ACKNOWLEDGEMENT

This Environmental Impact Analysis was prepared under the direction and with the active involvement of Urban Mass Transportation Administration, the Federal Highway Administration, Massachusetts Bay Transportation Authority, the Massachusetts Department of Public Works, the Central Transportation Planning Staff and with the assistance of the following firms in their designated fields:

Frederic R. Harris, Inc.	*General A/E Consultants*
Sub Consultants:	
Bolt, Beranek and Newman, Inc.	*Noise and Vibrations*
Carpenter & Co.,,Inc.	*Real Estate-Market Analysis*
Thomas K. Dyer, Inc.	*Track, Signals and Power*
Fay Associates, Inc.	*Train Operations*
H.I.I. Consulting Services Inc.	*Land Development*
Leggat, McCall & Werner, Inc.	*Industrial Development*
Stull Associates, Inc.	*Architecture, Urban Design*
Walden Research	*Air Quality*

In addition, during the course of the study, meetings and interviews were held with public officials, representatives of public and civic groups, as well as with private citizens. The cooperation of all is hereby gratefully acknowledged.

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contents

TABLE OF CONTENTS | PAGE

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (cont.)

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Cont.)

TABLE OF CONTENTS (Cont.)

LIST OF FIGURES

LIST OF FIGURES

LIST OF FIGURES (Cont.)

LIST OF FIGURES (Cont.)

LIST OF FIGURES

APPENDIX

A. Impact on Publicly-Owned Park Land and Historic Sites

B. Carbon Monoxide Concentrations - 1975, 1980 and 2000

C. Transportation Analysis

D. Rail Service Replacement During Construction

E. Rapid-Transit Traction Power Supply and Distribution

F. Engineering Details for Dropped Alternatives

G. Relevant Correspondence

H. Noise and Vibration Impact Analysis

I. Properties In The Southwest Corridor Owned By The Massachusetts Department of Public Works

J. Forest Hills Parking Facility

LIST OF APPENDIX FIGURES

LIST OF APPENDIX FIGURES (Continued)

LIST OF APPENDIX FIGURES (Continued)

1

1.0 INTRODUCTION

1.1 Study Description and Purpose

The findings of the environmental impact analysis for the City of Boston Southwest Corridor Transportation Project presented here includes several major project elements.

The major project elements analyzed (though not necessarily proposed for construction) include the reconstruction of the Orange Line transit and railroad facilities between South Cove and Forest Hills, the construction of an arterial street between Massachusetts Avenue and Forest Hills, the use of the Midland Division during construction, and parking facility at Forest Hills.

The transit component of the project is intended to provide improved rapid transit service into the densely built southwest area of metropolitan Boston. It provides for continuation and upgrading of long-term commuter rail and AMTRAK services. It also provides for removal of the existing Washington Street Elevated structure built in the early 1900s, between South Portal and Forest Hills.

The provision for replacement services to the South End and to Roxbury where the Washington Street Elevated is removed are the subject of a separate study. A commitment to provide replacement services has been made by the current and previous Secretary of Transportation of the Commonwealth. This service will be examined in a timely fashion in an Environmental Impact Analysis as approved under an UMTA Grant so as to result in the provision of such service as part of the phased removal of the Washington Street Elevated structure. Such service is contingent upon approval for capital funding as required by appropriate Federal Agencies.

The proposed arterial street would replace portions of Columbus Avenue and Tremont Street. The arterial street would improve traffic operations while strengthening developability of the unused land previously cleared for Interstate Highway 95 South.

The objective of this analysis is to determine the benefits and detriments effecting both the natural and the man-made environment resulting from construction of the project. Beneficial and adverse impacts would include changes to the following:

- Land Use
- Local and regional economy
- Regional and local traffic patterns
- Traffic movement
- Urban fabric of surrounding communities
- Air quality
- Noise
- Utilities

Each of these aspects of the environment are the concerns of this study in terms of potential changes accruing because of construction of the project and its related facilities.

1.1.1 Project Objectives

The objectives of the Southwest Corridor Transportation Improvements are manifold. Principle among these are:

1. To provide high quality transit and railroad service on an alignment designed to the highest environmental standards achievable in a dimensionally restricted corridor in a dense urban area.

2. To provide a large minority and low-income area of the City of Boston with good internal circulation and access to the core and suburbs. At the same time permit good access to the regional core for suburban residents in an intermodal project with efficient transfers between all modes.

3. To establish a beneficial match between commuter rail and rapid transit to expand the distribution and service characteristics of both.

4. To achieve increased access of the economic and physical redevelopment of the South End, Roxbury and Jamaica Plain as envisioned in the Southwest Corridor Development Plan and in the City's Renewal Plans for the South End and Campus High School.

5. To encourage the major joint development with local community participation of 120 acres of land cleared for I-95 south by the construction of residences, businesses, parks and community facilities (and the streets and transit facilities necessary to serve them); and the elimination of the damaging impact of the vacant land thereby.

6. To remove the blighting influence of the Washington Street Elevated and Penn Central Railroad embankment which for decades has reduced property value and caused environmental damage.

7. To replace redundant and poorly designed street facilities with more efficient roadways which are consistent in configuration and location with land use and development objectives.

8. To divert traffic from automobile to transit in general, and from local residential streets to arterial streets designed for this purpose.

9. To provide full execution of the Southwest Corridor plan of an estimated 16,000 construction and 2,400 permanent jobs and the provision of construction jobs for minority workers and subcontracts to minority businesses.

1.1.2 Study Sponsorship and Guidelines

The project is sponsored jointly by the Massachusetts Bay Transportation Authority (MBTA), as the regional mass transportation agency, and the Massachusetts Department of Public Works (MDPW), as the state highway agency. The impact analysis is part of an application for Federal assistance being made to the U.S. Department of Transportation (USDOT) through its subordinate agencies. These agencies are the Urban Mass Transportation Administration (UMTA) for the construction of the relocated Orange Line and the Federal Highway Administration (FHWA) for the arterial street construction. Depending upon the final configuration of the fringe parking facility at Forest Hills, funding may be sought from UMTA and FHWA.

Because Federal funds may be used for portions of this project, an environmental impact statement is required under Section 102 (2) (c) of the National Environmental Policy Act (NEPA) of 1969. An environmental impact report is also required under the Massachusetts Environmental Policy Act of 1972. The July 1, 1975 agreement between UMTA and FHWA designated UMTA lead Federal agency for this study. Therefore, this document will be processed under UMTA guidelines. This environmental analysis is the first step of the environmental review process for mass transportation projects as specified in UMTA Order 5610 1B, with attachments, and 5610.1, which contain the guidelines under which the study was conducted.

The material in this report serves as the basis for the environmental impact statement required before Federal funding can be approved. As such, it follows the Council on Environmental Quality's Guidelines for the preparation of Environmental Impact Statements (issued August 1, 1973).

1.1.3 Relationship to Other Projects

Several other projects are under discussion for the Southwest Corridor, including areas within the City of Boston, as well as suburban communities. A description and consideration of each is included in Section 4.3 of this document. The projects which are currently included in the Unified Work Program for the Boston Region, or are in design or construction are:

A. Transportation Improvements/Forest Hills to Needham - A consultant is currently under contract to the MBTA to produce an Environmental Impact Analysis including rapid transit and commuter rail alternatives on the Needham Branch right-of-way owned by the MBTA.

B. AMTRAK Upgrading - The Federal Railroad Administration is currently making extensive plans for improvement of rail facilities and service in the "Northeast Corridor" from Washington, D.C. to Boston. This includes High Speed Rail and AMTRAK service.

C. Commuter Rail Upgrading - A capital grant has been received by MBTA toward improvements of the Franklin Branch facilities and service. Improvement of the Stoughton and Providence services are anticipated as part of the MBTA's continuing Commuter Rail Improvements Program (CRIP). Acquisition of and improvements to commuter rail rolling stock are a subject of the MBTA's Capital Grant Application for CRIP-Phase II filed September 23, 1975.

D. South End/Roxbury/Dorchester/Mattapan Transportation Improvements - the MBTA received proposals from consultants on November 6, 1975, for an investigation of project alternatives and production of Environmental Impact Analysis for improved reservation transit service for these communities.

E. Circumferential Transit - The Central Transportation Planning Staff (CTPS) is currently investigating alternatives for cross-town transportation in the institutional-residential-industrial ring through Boston, Cambridge and Somerville in preparation for an Environmental Impact Analysis. The subject project provides right-of-way reservation for this project in South End.

F. Arborway Green Line - MBTA staff is currently developing a program of improvements to the Arborway Line in cooperation with the City of Boston.

G. South Cove Tunnel Extensions - Capital Grant Application has been submitted by the MBTA and approved by UMTA for this project. Its completion is an element in the provision of the Orange Line service between downtown Boston and South Cove and Back Bay.

H. Midland Division - A Capital Grant Application has been submitted by the MBTA and approved by UMTA for this project. Commuter rail service and AMTRAK trains may be diverted to the Midland Division during the construction of the Orange Line* enabling the project to move unimpeded by rail traffic within the immediate area of the construction of the Relocated Orange Line. This project, alone, could provide additional flexibility for railroad operations and would be the basis for transit improvements in the Dorchester, Mattapan, and Hyde Park areas.

*The impacts of the use of the Midland Division on commuter rail and on AMTRAK service is part of the Environmental Impact Analysis.

I. New Orange Line Cars - A Capital Grant has been received by the MBTA for the purchase of additional 65' long cars for the Orange Line.

J. Orange Line North - Service was initiated in 1975 on the new alignment from Haymarket Station to Malden Center with intermediate stations at Community College, Sullivan Square and Wellington. Further extension to the Oak Grove Station, near the Malden-Melrose Line, will be completed in 1976.

K. Other related transit improvements, such as the Arborway Bus Garage and operating improvements are described in the Transit Development Plan of the MBTA.

1.2 Study Context

1.2.1 Study Area Location

The general project area is the portion of the City of Boston bounded by the MBTA Red Line Ashmont Branch on the east, the downtown area on the north, the Riverway Arborway parkland on the west, and Cummins Highway on the South. The project begins at the fringe of downtown Boston and extends along the existing right-of-way of the Penn Central Shore Line to the vicinity of the Forest Hills commercial area at Walk Hill Street (Fig. I-1).

1.2.2 Project Description - Rail/Transit (Fig. I-2)

The MBTA's Orange Line runs north and south between Forest Hills and Malden Center. A northern extension to Oak Grove at the Malden-Melrose Line is under construction. The Orange Line is primarily located at grade or on an elevated structure except for the 1.1 miles of subway through downtown Boston under Washington Street, and a new tunnel under the Charles River from Haymarket Station to Community College Station. The elevated portion of the line is located above Washington Street, in the southwest portion of the City of Boston, and generally parallels the proposed relocation section.

The following transit and rail alternatives between South Cove and Forest Hills are the subject of this Environmental Impact Analysis.

- No Build/No Action
- Railbed on Modified Embankment (Raised and Widened)
- Railbed Depressed

These major options as well as alternatives dropped from consideration are discussed in detail in Section 4.

Proposed Transit/Rail Facilities

The following transit and rail facilities are proposed to be constructed as a result of this analysis:

- Relocate approximately 4.7 miles of the existing Orange Line from the South Cove area (south of Essex Station) through Back Bay Station and on to Forest Hills. The Line will consist of two tracks and will generally follow the present railroad right-of-way. The southern terminal of this project will be a new station at Forest Hills.

- Replace existing four-track railroad with three new tracks parallel to and east of the transit tracks, from South Cove Tunnel portal to Forest Hills. The tracks would occupy a common right-of-way from South Cove to Forest Hills, diverging at Forest Hills to Providence (Shore Line) and to Needham (Needham Branch), allowing either railroad or transit on the Needham Branch in the future.

- Both the transit and railroad tracks and station platforms would be constructed in a partially depressed section (modified-depressed alternative) between a point just south of Massachusetts Avenue and a point south of Forest Hills.

- Provide for the possibility of two future transit tracks on the Needham Branch and Shore Line (main line) beyond Forest Hills.

- Remove existing Washington Street elevated structure between South Portal and Forest Hills.

Nine stations, to accommodate six car Orange Line trains, are proposed at the following locations:

	Rapid Transit	Commuter Rail	AMTRAK
South Cove	X		
Back Bay	X	X	X
Massachusetts Avenue	X		
Northeastern/Ruggles Street	X	X	
Roxbury Crossing	X		
Jackson Square	X		
Boylston Street	X		
Green Street	X		
Forest Hills	X	X	

There are five existing stations in the Washington Street subways: Essex, Washington, State, Haymarket, and North Station. Although some of the platforms at these stations have been lengthened, some are still not long enough to accommodate six of the new 65-foot cars. This project will include lengthening of platforms and associated structural work and finishing at:

Essex (northbound)*

Washington (both platforms)

State (southbound)*

The project would also include finishing work on the already lengthened platforms at Essex (southbound), and Haymarket (both platforms), and State (northbound). With the lengthening of these platforms, all Orange Line stations from Forest Hills to Oak Grove will accommodate six of the new 65-foot cars.

This project allows for the future provision of improved commuter rail service with incremental conversion to Orange Line transit service along the Needham Branch.

No new rolling stock will be required for this project, as no additional mileage will be involved. The 100 existing cars may be modernized or replaced under an additional Capital Grant Application. They would be equipped for radio communication and cab signals. Additional cars may be needed as volume increases, and their acquisition would be provided for in conjunction with transit extensions.

1.2.3 Project Description - Arterial Street (Fig. I-3)

Current arterial travel in the corridor is an arduous task. The existing arterial route from Forest Hills to the core area is negotiated via a connection of streets, each of which is incapable of providing acceptable service.

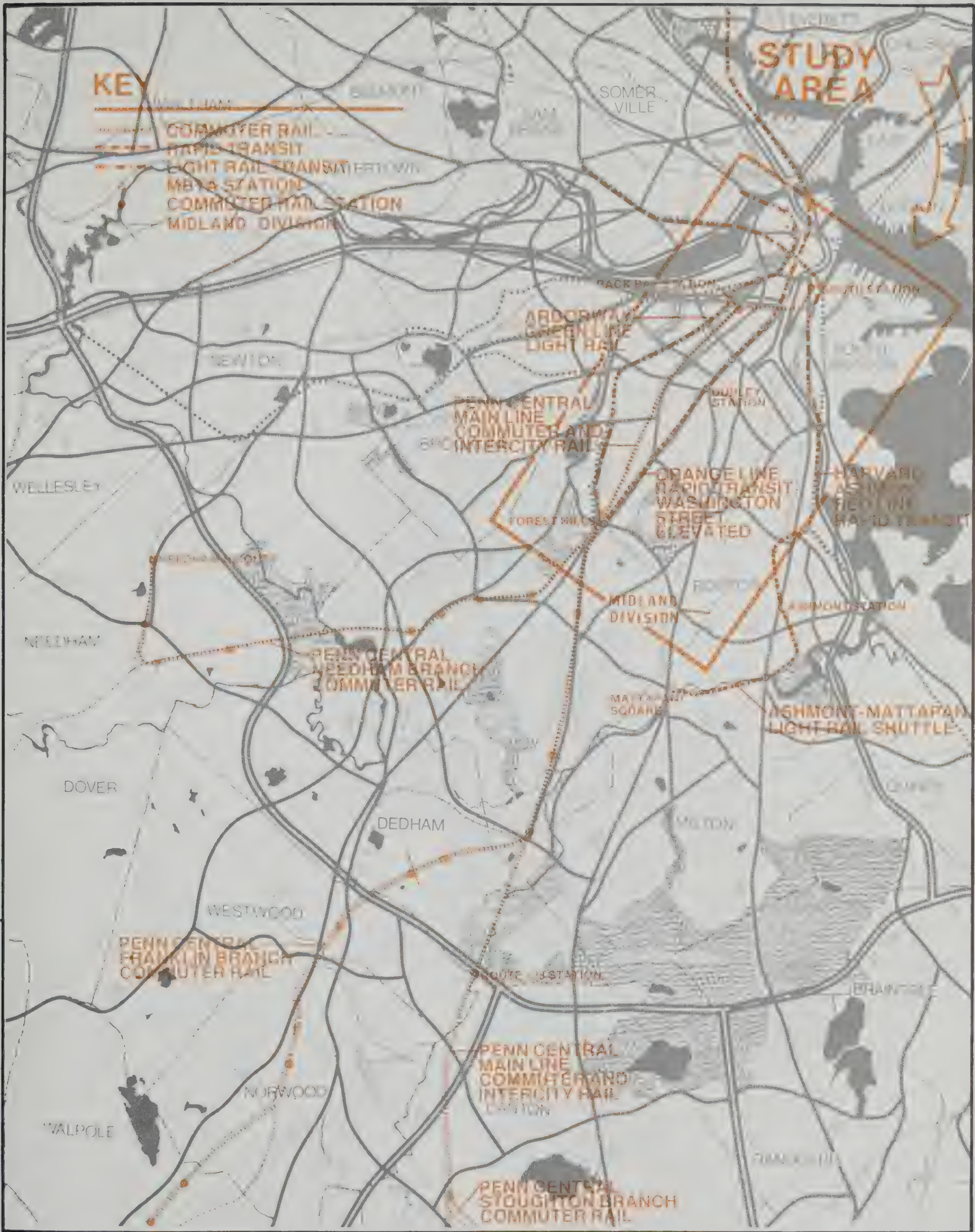
Two routes are involved which are characterized by truck loadings, local traffic congestion and parking problems. These conditions cause inconveniences to both drivers and pedestrians. The shorter route alternative is Lamartine Street or Amory Street to Jackson Square; Columbus Avenue to Roxbury Crossing; Columbus Avenue or Tremont Street to Massachusetts Avenue. A more circuitous route is Washington Street to Egleston Square, then Columbus Avenue to Roxbury Crossing.

Both routes are discontinuous, have complex intersections and are deficient in traffic carrying capacity.

Lamartine and Amory Streets, designed as residential streets, are deficient as arterials.

The alignment of Columbus Avenue at Roxbury Crossing is extremely poor. In addition, both Columbus Avenue and Tremont Streets have poor surface drainage and deteriorated roadbed and pavement.

* Includes Handicapped Facilities.



STUDY AREA LOCATION

NORTH

SCALE

0 1 2 3 4 MILES

FIGURE

I-1

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PROJECT LOCATION

RAIL TRANSIT ARTERIAL

LEGEND

- RELOCATED ORANGE LINE & RECONSTRUCTED RAILROAD
- PROPOSED STATIONS
- EXISTING ORANGE LINE TUNNEL
- EXISTING ORANGE LINE ELEVATED
- EXISTING STATION LOCATIONS
- STATION TO BE REMODELED
- ARTERIAL STREET

NORTH

SCALE

0 1200 2400 3600

FIGURE

I-2

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

ARTERIAL STREET SEGMENT MAP

LEGEND

▪▪▪▪ ARTERIAL STREET

SCALE

0 1200 2400 3600

FIGURE I-3

The Washington Street elevated transit structure presents the motorist with visual, physical and psychological problems. Piers located between lanes and at odd places introduce obvious restrictions. Additionally, Washington Street, basically a commercial street, serves poorly as an arterial with through motorists shoppers, and delivery personnel, in competition for the same limited space.

The proposed arterial street component of the project starts from Massachusetts Avenue at the connection to the Southeast Expressway, follows Ruggles Street in a westerly direction to the Penn Central Railroad, parallels the railroad to its termination at Forest Hills. Total length is about 3.8 miles.

The arterial street has been divided into three segments (Fig. I-3) as follows:

Segment #1 - Massachusetts Avenue to Ruggles Street

Segment #2 - Ruggles Street to Jackson Square

Segment #3 - Jackson Square to Forest Hills

It has been determined by Massachusetts DPW, with the concurrence of FHWA, after a review of engineering drawings, an evaluation of probable impacts, and after public response to newspaper announcements that Segment 1 would qualify as a "non-major action". As such, the National Environmental Policy Act of 1969 (NEPA) does not apply. Consequently, the arterial from Massachusetts Avenue to Ruggles Street (Segment 1) has not been included in this impact analysis.

The alternatives under consideration for Sections 2 and 3 are listed below and fully described in Section IV:

- No Build*
- Build Segment 2 only
- Build Segments 2 and 3

1.2.4 Regional Transportation Planning Context

A rapid transit line located on the Shore Line tracks of the Penn Central has been included in most major regional Planning studies of recent years. Documentation of the proposal for this Relocated Project by MDPW in 1968 and in the MBTA Master Plan resulted in a project for a rapid transit line located in the median of a major expressway leading into the heart of Boston.

In the recent past, regional planning was noted for the emphasis it placed on highway planning. This attitude was changed in the early 1970s, when the Governor stopped all new expressway construction within the Route 128 perimeter for a major restudy of the Boston region's transportation needs. Following the study made by the two-year, $3.5 million Boston Transportation Planning Review (BTPR), the Governor decided not to build the radial expressways planned for the region. He decided to rely more on mass transit to move people in the denser core area. The Commonwealth of Massachusetts adopted a "balanced" transportation policy, calling for a combination of transit and highway investments, planned as part of unified transportation system. The Southwest Corridor studies of the BTPR support the concept of major rapid transit, commuter and

* For a No-Build Alternative, only normal maintenance of existing streets would take place. The impact of choosing this option is used as a basis for comparison with the impacts of the Build Alternative. Selection of a No-Build Alternative will not rule out minor improvements to the existing local street system which would normally qualify as "non major Federal actions" under FHPM 7-7-2.

inter-city rail facilities on the alignment of the Penn Central trackage, paralleled by new or modified local streets and boulevards in place of the previously planned expressway.

The shift from highway to rapid transit and railroad construction in the corridor has been reinforced by Congressional adjustments to Federal programs for transit improvements. The Federal Highway Act of 1973 gave the states flexibility in using funds previously scheduled for interstate highway construction. Funds allocated for construction of the Southwest Expressway (Interstate 95) have thus become available for transit projects with a strong emphasis on the Relocated Orange Line as the top priority of the corridor.

The Relocated Orange Line has been given a high priority in the region because of its key role in relation to other projects now being planned. Many of the longer-term projects will be influenced by construction of this project for an orderly, scheduled implementation at a later date. In addition, the project has had a relatively long period of gestation and growth, through agency investigation, community exploration and involvement. These elements are reflected in the current Transit Improvement Program for the Boston Region, which includes a summation of the many projects being considered for transit improvements in the region, together with a description and scheduling of projects over the next decade or more. In this tabulation, as in all recent documentation, the Relocated Orange Line is of the utmost importance and highest priority for the region.

Several of the emerging transportation plans build upon the proposed Relocated Orange Line for improved transit service. Chiefly, these are possible future transit extensions beyond Forest Hills to either West Roxbury or Route 128 in Needham, but they include an orderly upgrading of the commuter rail and AMTRAK services which utilize this corridor for access to Boston. These possible future line extensions or improvements have been analyzed in Section 5.1 considering the changes they might produce in transit ridership for the Relocated Orange Line if they were implemented.

1.2.5 Historical Background of Study

The Relocated Orange Line is proposed for a railroad alignment which is one of the oldest in Massachusetts. The line was built as part of the Boston and Providence Railroad Company, chartered in 1831 and first opened to passenger service in 1834. In 1888 the line was leased by the Old Colony Railroad Company, in an effort to forestall impending New Haven Railroad competition with its profitable Fall River - New York passenger steamers on Long Island Sound. The New Haven, however, gained the upper hand under the guidance of J.P. Morgan, who leased the Old Colony system in 1892, thereby completing a through route for the Shore Line between New York and Boston and opening an era of extensive passenger service in the corridor.

Passenger service on the Shore Line and the tributary commuter rail lines sharing the roadbed was so extensive that most early transit extension plans assumed its permanent viability. Early plans for a corridor expressway respected the presence of the rail service, retaining trackage and service on the existing right-of-way. By the mid-1950s, rail service had begun to decline, the proposed expressway joined the interstate highway system, and shortly thereafter, it was recommended that the existing Orange Line on the Washington Street El be relocated to the median of the highway. By 1967, the MBTA and the State Department of Public Works had completed sufficient analysis of the joint expressway-and-rapid transit scheme to embark on initial land acquisitions in the corridor and construction of the South Cove Tunnel.

In September of 1968, the MBTA initiated construction on a segment of the South Cove Tunnel. This new tunnel forms a junction with the existing Orange Line Tunnel at Washington and Kneeland Streets and extends to the right-of-way of the Massachusetts Turnpike. South Cove Station, is included within the confines of the tunnel, and is located on Washington Street in front of Don Bosco High School and across the street from the New England Medical Center Hospitals. This project was initiated by the Authority with $13.3 million of

100% local bond funds because urban renewal construction scheduled for the South Cove area could not be delayed and the Federal Government did not have sufficient funds at that time (1968) to assist in the financing of this project. In 1972 the tunnel and the shell for the new Medical Center Station were completed and urban renewal construction has proceeded above the facility.

Clearance for I-95 and the Orange Line involved the relocation of over 700 households and 300 businesses in the communities of the corridor. Most of the clearance took place north of Forest Hills. Damages were not limited to the actual highway takings. Uncertainty about the impact of the highway on properties adjacent to the right of way contributed to a pattern of neglect and inaction. This accelerated neighborhood deterioration along the potential path of the road. The deterioration continues today.

Controversy over the impacts associated with the expressway system mounted and in 1970, further planning and construction was halted pending a full scale review of transit and highway plans in the metropolitan area by the Boston Transportation Planning Review. As part of that review a series of public hearings were held on the findings of the technical effort and the recommendations of community groups, municipal and institutional agencies. On October 30 and 31, 1972 public hearings were held on the Southwest Corridor transit and highway project, attended by an estimated 1700 persons. The speakers at the hearing, while bitterly divided over the question of the proposed expressway, were nearly unanimous in support for the Relocated Orange Line. Transcripts of these hearings are available through the MBTA.

Following the hearings and the major work by the BTPR, the Governor dropped plans to continue I-95 into Boston. He urged top priority for Southwest Corridor transit investment to provide improved mobility for corridor residents, and to spur renewal of the land cleared for the expressway. He also urged further exploration of the merit of depressing the rail facility, and an examination of the means of providing service to replace the loss of the Washington Street El in the heart of the South End and Roxbury. As an integral part of the development plan, the Governor appointed a Development Coordinator in mid-1973 to work with agencies, officials and community representatives toward implementation of corridor transportation elements and land development. Following the completion of the BTPR, the Southwest Corridor Development Coordinator has established consensus around the direction of this project.

This document represents the distillation of the efforts of the MBTA, the Southwest Corridor Development Coordinator, the Central Transportation Planning Staff with cooperation from MDPW, the Metropolitan Area Planning Council and many other agencies. The extensive contact with the community throughout the process has been documented and summarized in Section 1.3.3.

1.2.6 Major Issues

The transcript of the previous public hearings on the Relocated Orange Line contain major issues raised by citizens concerned about the project. Residents who spoke at the two hearings expressed concerns that the rail facilities should be depressed below grade to alleviate noise and visual impacts, and that delays in construction should be minimized.

The public participation process which has been underway since the hearings has revealed that these issues are still a concern of residents, and others were brought up:

1. Disruption during construction.
2. Disposal of spoils from excavation.
3. Details of pedestrian, bus and automobile access to stations.
4. Interest in joint development at station locations.

5. Open space green belt development.

6. Influx of new vehicle traffic from the suburban bedroom communities.

7. Potential high speeds on the proposed arterial.

8. Desire for continued rail commuter service to Back Bay Station during construction.

9. Potential increased noise and vibration due to the added rail and transit traffic expected.

10. Concern for the electric arc flashing during nighttime hours if catenary power is used.

11. Need for security fencing of the rail/transit facility.

12. Concern for personal security within the stations as a result of the project.

13. Changes in property values.

These items are among those addressed within the specific alternatives described in this report.

1.3 Method of Study

1.3.1 The Technical Analysis Process

An environmental impact analysis is essentially a comparative one. The present is judged against the future. The future, with a given project is compared to a future without that project. Based on work by the BTPR, this analysis follows that same logical structure. First, the BTPR study team took an inventory of the existing environmental conditions through field work, interviews, research of published sources, and public meetings. Next, future changes in existing conditions were projected under the assumption that the Relocated Orange Line would not be built. This was done through the use of computer models, professional judgments, interviews with local officials and experts, and experience in similar situations. This set of projections comprised the "No-build" future of the alternative without the project.

The study team prepared a set of alternative configurations for the Relocated Orange Line project, as described in Section 4, and projected future conditions under each of the selected "build" alternatives. The resulting comparisons with the no-build future indicated the impacts attributable to the project and provided much of the material for this report.

The environment in which the project would be built was divided into a number of component parts - the transportation system, air resources, water resources, noise conditions, community and economic resources, and visual character. Each environmental component became an element of the technical study, using the analytic techniques relevant to the particular discipline. Two other study elements comprised the environmental analysis -- the community participation program, described in Section 1.3.3., and the preliminary engineering and design, which provided more precise definitions and specifications for the project alternatives.

The study process did not proceed in discrete steps, but involved continual interactions between the study team members, the community, and appropriate public and private agencies. The result was an exploration of issues and discovery of major community concerns. This in turn, resulted in additions and revisions of the data base to refine and evolve alternatives.

1.3.2 Geographic Scale of Analysis

The diversity of the study elements dictated analysis over a variety of geographic scales, from the regional to the site-specific. A set of geographic areas, rather than a single area, was chosen to fit the differing needs of the various elements, with each comprising the "study area" for the appropriate elements.

Regional trends and transportation systems were considered at a regional scale, which included all the communities in the Southwest Corridor. A smaller study area composed of the inner portions of the Corridor was used for traffic analysis and for part of the community and economic studies. A community scale of analysis was defined, covering the portions of Boston which form distinct subareas. This scale proved useful for air and noise analysis, neighborhood and land use analysis and some traffic and ridership studies.

The more physically oriented studies, such as geology, water resources, ecology, visual analysis and design, demanded the smaller coverage and greater detail of a project area scale, typified by graphics showing alignment and station locations. The smallest area used in the analysis was the specific station site, covering the immediate station area.

1.3.3 The Public Participation Process

Work of the Boston Transportation Planning Review intensified the process of public participation in the Southwest Corridor. The BTPR Working Committee, as well as numerous public information meetings and workshops and briefings,

brought the BTPR staff together with representatives from Corridor neighborhoods; regional organizations concerned with transportation, land use and environmental questions; state and local agencies; business and professional organizations; elected officials and private agencies and organizations. The BTPR's technical staff was made available to participants both at meetings and on an informal, individual basis through the coordination of the Community Liaison and Technical Assistance Staff.

Public awareness of transportation issues in the Southwest Corridor was at a high level. This fact together with immediate problems related to highway land takings, required that the Southwest Corridor participation process be aimed at working very closely with neighborhoods - involving them in the study of long range transportation/land use questions as well as in the solution of short term problems such as the interim use of land that has been acquired by the Department of Public Works.

Work done in the Southwest Corridor subsequent to the BTPR, has increased the scope and intensity of the public participation process. This work remains on-going.

The goal has been to develop a working partnership - expected to last for some years - with individuals, agencies, and organizations throughout the Corridor, and to provide continuous community liaison and technical assistance to be sure that people's concerns will be reflected throughout the long process of Corridor redevelopment. This partnership has led to the refining of alternatives as presented in this document and will continue through the design and construction.

To that end, the following specific techniques have been used:

A. In 1973, a Southwest Corridor Development Coordinator was appointed by the Governor to coordinate the workings of the large number of agencies involved in redevelopment. The Development Coordinator opened a site office at 8 Asticou Road, Jamaica Plain, in approximately the center of the Corridor. The site office maintains a full staff and a complete set of maps and documents having to do with Corridor affairs. It also provides a convenient place for holding small workshops and meetings. The work of the office is well known throughout the Corridor by this time through newspaper publicity, mailings and the publication of a telephone number to be used for all Corridor emergencies and problems. The Southwest Corridor General Mailing List, used to advertise public information meetings and for periodic updates on Corridor affairs, contains 975 names.

B. The Coordinator's office conducted an extensive survey of all groups, agencies and organizations with actual or potential interest in the Corridor. Each has been asked to have a representative sign a Memorandum of Agreement. The signatories included private organizations and those state and local agencies having statutory responsibility for Corridor development.

C. All of the signatories of the Memorandum of Agreement make up the membership of the Southwest Corridor Working Committee. This body meets at regular intervals as a policy advisory committee to the Southwest Corridor study process on issues of Corridor-wide concern.

D. A separate committee has been set up in each of the Corridor neighborhoods to deal with purely local maintenance and development issues. Included among these local groups are the Roxbury South End/Mission Hill Neighborhood Committee and the Jamaica Plain Neighborhood Committee.

E. Special Task Forces have been created to deal with certain Corridor issues that require intensive study. These have been:

- The Task Force on Commuter Rail
- The Task Force on Interim Land Use
- The Task Force on Long-Term Planning and the Scope of Services for Corridor Consultants
- The South Cove Tunnel Task Force
- The Forest Hills-Needham Public Transportation Improvements Steering Committee
- The South End/Roxbury Transportation Improvements Committee (including representatives from Dorchester and Mattapan)
- Task Force on Open Space
- South End/Saint Botolph Task Force (Noise and Acquisitions)

F. Publicity has been extensive; a mailing list is maintained for each committee and meetings are announced at least two weeks in advance, by letter. In addition, most meetings are advertised in local newspapers by way of front page articles describing some aspect of Corridor affairs. Radio spots are used in the case of very large or very important meetings.

Full minutes are taken at each meeting and distributed to every name on the mailing list along with notification of the next meeting. The minutes are complete enough so that anyone missing the meeting will have a very good idea of what was said, by whom, and what decisions were made.

A letter updating Corridor issues is sent out to the General Mailing. List approximately four times per year. The mailing lists are continually updated to include all those attending meetings or calling in to request that they receive information.

1.4 Organization of the Environmental Impact Analysis

This report is organized to fulfill the administrative and legal requirements of the various Federal and State regulations, and to make it easy for readers to find specific information of interest to them. The rest of the document contains the complete environmental evaluation of the project alternatives.

The document consists of seven sections and is organized to parallel the guidelines in UMTA Order 5610.1.1B. It begins in Section 2.0, with a description of the existing environmental conditions. The transportation system need for the Relocated Orange Line is discussed in Section 3.0. The process of defining alternative ways of addressing the transportation needs, and the specific alternative chosen for study are presented in Section 4.0. Section 5.0 details the probable impacts of each alternative and is probably the most important section of the analysis. The adverse environmental impacts are highlighted in Section 6.0 together with means of ameliorating harmful effects. Section 7.0 discusses the short and long-term benefits and consequences of the project against a background of immediate impacts on the region and local communities. Finally, in Section 8.0, the existing commitments to the project and its further resource commitment are tabulated.


2

2.0 STUDY AREA DESCRIPTION

2.1 Physical Setting

The general project area is the portion of the City of Boston bounded by the MBTA Red Line Ashmont Branch on the east, the downtown area on the north, the Riverway-Arborway parkland on the west, and Cummins Highway on the south. The project begins at the fringe of downtown Boston and extends along the existing right-of-way of the Penn Central Shore Line to the vicinity of the Forest Hills commercial focus at Morton Street. Major man-made features are the densely developed older inner neighborhoods of the city; the extensive embankment of the Penn Central; the linear open space cleared for the previously proposed I-95 expressway; the existing elevated transit line extending the full length of Washington Street; the high over-pass of Morton Street at Forest Hills; scattered industrial establishments adjacent to the railroad right-of-way; and the new community facilities and housing created through urban renewal.

Prominent buildings near the alignment of the project include the 60-story John Hancock Tower, the Prudential Center, Northeastern University, the Mission Hill and Whittier Street Housing projects at Ruggles Street, the new Campus High School complex at Roxbury Crossing, the Bromley Park and Heath Street public housing projects at Jackson Square, and the West Roxbury Court House and MBTA Arborway terminal at Forest Hills. (Fig. II-1).

The three most dominating components of the physical surroundings within the study area are unquestionably the Elevated Orange Line along Washington Street, the Penn Central Embankment and the Land Cleared for I-95.

Washington Street Elevated Orange Line (Fig. II-2)

The Orange Line presently operates on an elevated steel structure along Washington Street between South Portal and Forest Hills. There are six stations which serve the elevated along the route. The stations vary in complexity from the simple suspended platform type (Northampton Station) to a combined bus-transit complex at Dudley Station.

The elevated Orange Line was constructed in the early 1900s using a structural system of two column steel bents supporting four large longitudinal steel girders. They, in turn, carry the ties and track for both the north and southbound Orange Line.

A major portion of the line has been constructed using plate girder bents combined with either plate or truss-type longitudinal girders. A third major section extending north and south of Northampton Street Station is constructed of Arched Truss Bents combined with longitudinal truss girders. In the vicinity of Forest Hills stations, the structural system utilizes steel encased in concrete.

Although the structure is currently being painted, the last general painting of the "El" occurred during the 1930's. The southerly end of the structure from Green Street to Forest Hills was painted in the late 1940's. During the construction of the Massachusetts Turnpike (1962-1965) the portion of the "El" passing over the pike was repainted.

The overall height (from street level to top of rail) varies between 25 and 35 feet. The two-track structure has an overall width which varies between 25 and 45 feet placing columns both in the street and on the sidewalks. At stations, the structure widens to allow for platforms and track curvature.

The elevated structure is the most dominating physical feature along Washington Street as it passes through Jamaica Plain, Roxbury and South End communities. Columns conflict with both street and sidewalk travel. Corrosion is prevalent; dripping rust during rain and snow. Noise levels are a substantial 100 dB during transit operations.

Washington Street itself primarily contains retail establishments for the most of its length. Some housing south of Egleston Square and light industry in the area of McBride/Williams Streets are also adjacent.

Land Available (Fig. II-3, II-3a)

Approximately 108 acres of land have been cleared for Interstate 95 South or other public purposes in the area between Forest Hills and Massachusetts Avenue. Most of the building demolition occurred between 1966 and 1970. However, demolition continued on a sporadic basis through 1975. It is likely that additional buildings will be raised in 1976. In the meantime, the land has remained undeveloped, with the exception of temporary uses north of Forest Hills.

The cleared right-of-way involves a substantial area. This fact, plus the indecision as to its ultimate use, has contributed to the deterioration of surrounding neighborhoods.

The right-of-way was cleared for a width of 300 to 500 feet between the Central Artery ramps at Massachusetts Avenue and Ruggles Street leaving approximately 33 acres barren.

From Ruggles Street to Jackson Square, the clearing was primarily to the east of the existing Penn Central Embankment and on both sides of Columbus Avenue which parallels this segment. In all, approximately 29 acres are undeveloped in this segment.

Approximately 46 acres of land were cleared primarily to the west of Penn Central embankment between Jackson Square and Forest Hills. There are several buildings in each segment which still remain within the right-of-way taking line established for Interstate 95 South. Nearly all of these buildings are currently owned by the Massachusetts Department of Public Works and are leased subject to a one-month termination.

A listing of D.P.W. owned structures presently occupied is presented in the Appendix to this report.

Penn Central Shore Line Right-of-Way (Fig. II-4)

The Penn Central right-of-way (as it relates to the Orange Line project) begins at the proposed South Cove Portal located adjacent to and south of the Massachusetts Turnpike Extension beneath Arlington Street. The right-of-way from that location parallels the south side of the turnpike to Back Bay Station, a distance of approximately 0.6 of a mile. This section is below the grade of the surrounding terrain. The turnpike is below grade as well. A frontage road is adjacent to the tracks on the south side from Shawmut Avenue to Arlington Street. Commercial buildings abut the right-of-way between Arlington Street and Back Bay Station.

The bridges over the railroad in this section are as follows:

Location	Type of Span
Tremont Street	Steel Stringers
Arlington Street	Brick Arch Spans
Berkeley Street	Through Plate Girder
Columbus Avenue	Steel Stringers
Clarendon Street	Steel Stringers
Foot Bridge	Reinforced Concrete

Many of these structures were built in the late 1800s. Four tracks serve the Penn Central Shore line in this area.

The railroad right-of-way is generally located below the grade of the surrounding terrain from Back Bay Station to Chickering Tower. The right-of-way gradually rises to meet existing grade in the vicinity of Gainsborough Street.

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PROJECT AREA
PROMINENT LANDMARKS

LEGEND

▲4 IMPORTANT LANDMARKS

SCALE

0 1200 2400 3600

NORTH

FIGURE

II-1

FREDERIC R. HARRIS INC.

FIGURE: II-1

PROMINENT LANDMARKS

FIGURE II-2

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PROJECT AREA
PROPERTY MAP

LEGEND

PROPERTY OWNED BY D.P.W. OR OTHER PUBLIC AGENCIES OR CLEARED, PRIVATELY OWNED LAND.

SCALE
0 1200 2400 3600

FIGURE II-3

FIGURE II–3A

FIGURE II-4

Within this section (approximately 0.7 miles in length) the right-of-way is abutted by residential buildings. An exception is the Boston Arena and Northeastern University.

The bridges over the railroad in this section include the following:

Location	Type of Span
Back Bay Station Parking Area	Brick Arch on columns
Dartmouth Street	Girder on Columns
Irvington Street Foot Bridge	Through Truss
Signal Bridge	Truss
Follen & Braddock Park Foot Bridge	Truss
West Newton Street	Enclosed Deck Plate Girder
Durham & W. Rutland Square Foot Bridge	Truss
Massachusetts Avenue	Rolled Beams
Gainsboro Street Foot Bridge	Through Plate Girder

These structures are also estimated to have been built in the late 1800s. The Penn Central tracks are then supported on a man-made earth embankment for a distance of three miles from Chickering Tower near Gainsborough Street to Forest Hills. The embankment was constructed in the mid-1890s and bridged the streets and ways existing at that time. It presents a formidable barrier to cross movement in the corridor. Currently, there are sixteen steel track bridges, a five-span stone arch, and one concrete pedestrian underpass. These structures were built during the original construction and strengthened for heavier loading in 1914.

Bridge crossings are located at:

Location	Type of Span
Ruggles Street	Through Plate Girder Spans
Prentiss Street	" " " "
Station Street	" " " "
Former Station Drive	" " " "
Tremont Street	Steel Arch Spans
New Heath Street	Through Plate Girder Spans
Heath Street	" " " "
Centre Street	" " " "
Atherton (Mozart St.)	" " " "
Boylston	" " " "
Lawndale Terrace	Concrete Arch (Pedestrian)
Green Street	Through Plate Girder Span
Williams Street	" " " "
McBride Street	" " " "
Morton Street	Stone Arch Span
Asticou Road	Steel Arch Span
Walk Hill Street	Through Plate Girder
Washington Street	Through Plate Girder

The Arborway at Forest Hills is the only bridge over the embankment section.

Existing vertical clearances between the local street (under) and the railroad structures in this section range generally from 11 feet to 15 feet. The City of Boston requires 16'-0" vertical clearance over city streets for any new construction.

Four former stations are located within the embankment section: Roxbury Station, Heath Street Station, Boylston Street Station and Jamaica Plain

Station. These stations have been abandoned and all that remains are the concrete platforms and the stairways leading to them. The areas have been fenced off and all of the pedestrian underpasses have been bricked-up with the exception of one. This exception is located at Minton Street and is used primarily by school children attending Our Lady of Lourdes School.

The condition of these structures (rated for 79 mph line speed) is considered fair. They have a rated capacity of 263,000 pounds for a four axle car.

In addition to the four main line tracks, there is one active sidetrack on the embankment near the Green Street underpass.

2.2 The Human Environment

2.2.1 Geography and History of the Area

The City of Boston is located in a basin, a broadening of the coastal plain, defined by a rim of hills and ridges, remnants of a series of fault lines.[1] The hill and ridge definition is strongest in the north, west and south, breaking down in the southwest, where the basin is interrupted by drumlin formations[2] roughly three miles from the State House. This varied hill pattern is broken by two valleys - one following the Neponset River and the other following the original course of Stony Brook. The valleys come together just to the southeast of the Stony Brook Reservation, in the Hyde Park section of the City.

The project area is located in the valley of the Stony Brook, where the early railroad was constructed to take advantage of easy gradients. Further influence of landform on development patterns is illustrated by the closeness of fit between densely urbanized areas and the limits of the Boston basin and the lowland river valleys which pass through the basin's rim. These were the lands easiest to build upon, and they contain the oldest sections of the metropolitan area. The net effect was the creation of Boston basin urbanized area of multi-family dwellings and higher density job concentration, where urban problems and opportunities are most concentrated. This area contains the highest number of people and buildings per acre, and the highest level of disturbing ambient conditions such as deteriorating structures, air pollution, noises, dust and vibration.

The break in the rim of the Boston basin to the southwest permitted high-intensity development that extends almost to Route 128, where the Blue Hills and wetlands of the Neponset watershed provide natural barriers or limits to the pattern of urbanization. Within the Southwest Corridor, little of the original natural ecology has been left untouched by development. Specific parks and reservations have been provided to the great benefit of the residents of the City, but the original watercourse of the Stony Brook has been almost completely placed in culvert.

The landform (Fig. II-5) was a particular determinant in the location of the early roads and first settlements. Early roads in the proximity of the Corridor included: Washington Street (which, before the filling of Back Bay, was the only road along the neck to the Boston peninsula and which then proceeded to parallel Stony Brook), Centre Street and Perkins Street in Boston; and Brush Hill Road and Blue Hill/Canton Street, in Milton.

Farms were built up throughout the area south of the peninsula. In the latter half of the Eighteenth Century summer estates for wealthy Boston families were established in the Jamaica Plain area because of its scenic values.

The Boston and Providence Railroad was built along the upper Neponset and along the western side of Stony Brook Valley in 1834. Nearby lands were opened up for industry and for residences for commuters.

The latter half of the Nineteenth Century brought rapid changes. In the 1870s the street car line along Washington and Centre Streets from Roxbury to West Roxbury spurred large scale residential growth. Boston's need for parks became a real concern and major urban works by Frederick Law Olmsted resulted in the Boston Park System (the emerald necklace). The Olmsted Park System, which includes the Arborway and the Arnold Arboretum, is now on the National Register of Historic Places.

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[1]See Section 2.3.3. Geology and Soils

[2]Ibid

In 1909 the Forest Hills extension of the Boston Elevated Railway on Washington Street was completed and the rapid development of Roslindale and West Roxbury followed in the classic tradition of "streetcar suburbs".

The waves of growth after each transportation service improvement have resulted in a series of neighborhoods in the Corridor with characteristics representative of the architectural styles prevalent when they were built.

2.2.2. Community Context

2.2.2.1. Neighborhoods (Fig. II-6)

Neighborhood Character - South End, Fenway, St. Botolph, South Cove and Back Bay

The existing Penn Central Railroad forms the boundary separating the South End from Back Bay and the Fenway. However, the railroad may be more significant in providing the boundary between the downtown commercial functions of the Back Bay and the primarily residential sections of the South End.

Since completion of the Prudential and Hancock Centers, and the recently completed Christian Science Complex, Back Bay has become a high intensity adjunct of the older portion of Downtown Boston. Simultaneously the South End has undergone a substantial change through the urban renewal process, which has transformed the section of South End adjacent to Back Bay into a recognized historic residential district.

This section has had great appeal because of its links to Downtown or Back Bay. It has also traditionally been host to the newly arrived immigrants to the City. Vestiges of the ethnic and racial backgrounds are strong in the South End. Tremont Street and Columbus Avenue - parallel to the railroad - are lined with shops of great diversity, reflecting the mix of backgrounds of the people who meet and live together in the South End.

Most of the housing in the South End is constructed in mid-nineteenth century row-houses, except in those instances on the major avenues where urban renewal clearance provided a higher density/replacement building. Commercial facilities are scattered throughout the neighborhood, and most South End residents find other shopping goods reasonably close at hand, either in Downtown, Back Bay, or at Dudley Square. Access to shopping is provided by local bus or by the Washington Street El, which dominate the center of the South End.

Housing stock has deteriorated much more rapidly in the vicinity of the El. Renewal actions here have been somewhat slower, due to the uncertainties surrounding the El's removal. Vacancies in housing are much more pronounced in the Washington Street Corridor. These vacancies may have been mitigated by the massive presence of the Boston University Medical Center and the Boston City Hospital located in an area of the South End which is farthest from the corridor of rails.

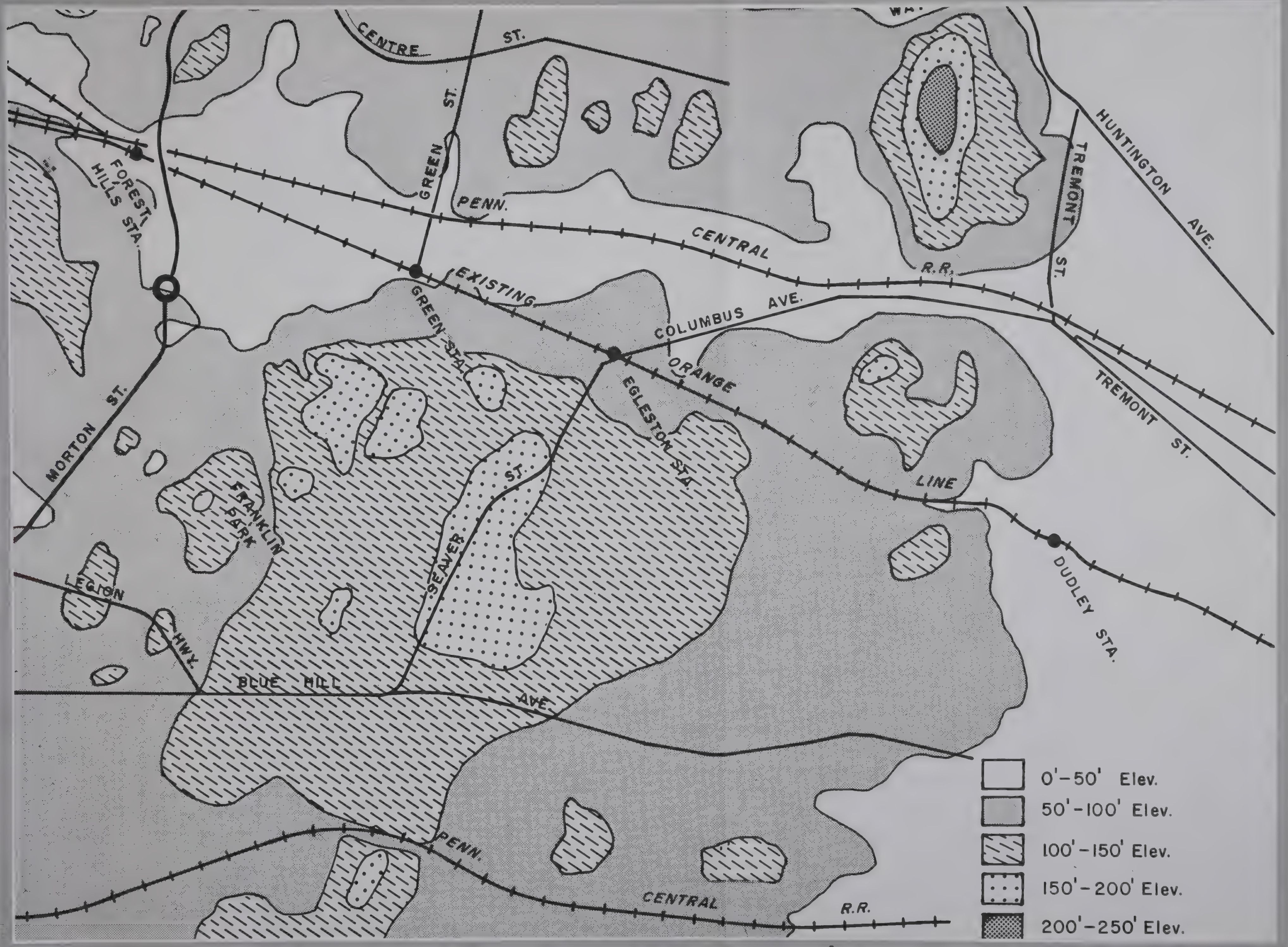
By contrast with the South End, the Fenway district contains several small neighborhoods surrounded by large institutions and has the subtantial open space of the Back Bay Fens, or Fenway. Two major museums, six major colleges, and numerous medical institutions focused on the buildings of the Harvard Medical School are in Fenway. The institutions which are most affected by the Relocated Orange Line are Northeastern University, Wentworth Institute, and the Museum of Fine Arts. Each of them is situated close to the project corridor.

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PROJECT AREA
LAND FORM



SCALE 0 1200 2400 3600

NORTH

FIGURE II-5

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PROJECT AREA
NEIGHBORHOODS

NORTH

SCALE

0 1200 2400 3600

FIGURE II-6

Housing in the area is varied. It contains extensive student accomodations in the vicinity of Northeastern and the Museum. It has the large Mission Hill and Mission Hill Extension housing projects located between the corridor and the Harvard Medical Area complex.

The St. Botolph neighborhood (lying directly adjacent to the existing Penn Central Railroad and extending north to Huntington Avenue) has been variously affiliated with both the Back bay and the Fenway district. Predominately residential, it has an architectural character similar to that of the South End. The St. Botolph neighborhood contains many long-time elderly residents and many transient residents, as well as a number of owner-residents. It is small in area and diversity. It relates directly to the Prudential Center and is clearly affected by its proximity to the railroad.

The South Cove is part of the Central Area and exhibits many of its characteristics such as dense housing, commercial and institutional buildings. It contains the Bay Village neighborhood, the New England Medical Center and is the heart of the Chinese residential community. A large amount of moderate-income, high-rise housing has been built in the past five years along the Massachusetts Turnpike which forms South Cove's Southern boundary.

In the Back Bay, the much delayed 1.5 million square foot John Hancock Tower, which will house 10,000 persons, should open in the near future. The mini-tower at Prudential Center is now nearly fully occupied. This represents significant new employment in the area with Boston Gas' and Gillette's corporate headquarters among those adding an estimated 8,000 people to the daily work population.

Several other projects in the area are at various stages of implementation: the 3 million square foot, mixed-use Park Plaza Project, a new Western International Hotel, and a new Bergdorf Goodman Store at Prudential Center. These projects represent the latest execution of the City's "High Spine" concept for growth of the downtown. This concept requires the location of high density residential, office and commercial retail uses in a linear spine connecting the downtown financial district to the Fenway Urban Renewal Area at Northeastern University, as the prime real estate development sector of the core. This spine parallels the alignment of the Penn Central Railroad between South Cove and Northeastern University. Thus, the South Cove/Back Bay transit link is critical in allowing the development of the region's economic base. Without the access it will provide, growth will be hindered and automobile based transportation to this growing sector of the city would be encouraged.

If constructed, the South Cove/Back Bay branch of the Orange Line would directly serve this expanding market and development area. The Green Line has become drastically overcrowded during recent years (in both inbound and outbound directions during the peak hours) owing largely to growth at Prudential and on Boylston Street in Back Bay. Because of its proximity to the trunk of the Green Line, the Orange Line connection to Back Bay will provide much needed relief for those making trips to and from Back Bay and the Boylston Station area of the South Cove. It is predicted that the opening of service to South Cove and Back Bay Stations will relieve overcrowding on the Green Line caused by boardings and alightments at Boylston, Arlington and Copley Stations, as well as draw new riders to the system.

Neighborhood Character - Roxbury and Mission Hill.

The South End and Roxbury merge south of Massachusetts Avenue. The exact boundary is indeterminate, but near Ruggles Street, the area is known as Lower Roxbury. This area was to have been the interchange of two expressways - the Southwest and the Inner Belt - and consequently land takings were most severe in the vicinity. Urban renewal clearance has added to the impact, but gradually new construction has filled the space. The Campus High School is the largest single project. It is closely followed in scale by the sheer volume of new housing throughout the area.

Dudley Square is the commercial heart of the area. It is located on the far side of the Campus High School project some distance from the rail lines. Once the terminus of the Washington Street Elevated Line, Dudley progressed toward major retail status, enhanced by the location of city service office and court functions nearby. The blighting impact of the snaking elevated lines overhead - along with other business factors - have taken a heavy toll on Dudley. Changes in competition from the suburbs has been further aggravated in this inner city area by an actual decline in population and buying power.

Although Dudley enjoys centrality in Roxbury, benefitting residents from South End, Dorchester, Jamaica Plain, it clearly has an advantage because of its position as an important modal transfer point on the transit network. While rehabilitation is important to maintain Dudley as an important community resource, additional development in the cleared lands adjacent to the rail tracks should be carefully studied to encourage economic revival.

The remainder of the land cleared for the Inner Belt lies to the east of Dudley Square terminating in the South Bay industrial district situated between North Dorchester and South Boston. Boston City Hospital is a major medical institution serving many project area residents as well as the City of Boston generally. It is located at Massachusetts Avenue at the entry ramps to the Central Artery. Many viable manufacturing structures and the Orchard Park Housing Development abut the land cleared for roadway use in the area between Dudley Square and City Hospital.

Mission Hill, to the west of the tracks, is a residential community closely related to the medical complex of the Fenway, but is constantly alert for encroachment by the institutions. The community is crowned by the steep grades of Parker Hill, and centers on the looming Mission Church halfway up the hill. The top of the hill is the site of yet another institution - the Robert Brigham Hospital. Housing is high density, basically three decker construction, with a great many vacant parcels scattered throughout. On the southern portion of the hill some industrial uses remain adjacent to the railroad embankment.

Between Roxbury and Mission Hill, the rail tracks and the cleared land right-of-way is accented by steep grades rising to Parker Hill on the west and Fort Hill on the east. The valley between the two hills has historically been a physical and social divider between the two communities on either side. This division is being broken down by migration of population from Roxbury into Mission Hill areas over the past few years. A similar population division and recent alteration has occurred between Roxbury and the northern portion of Jamaica Plain.

Neighborhood Character - Jamaica Plain

The community of Jamaica Plain begins approximately in the vicinity of Jackson Square and extends on both sides of the embankment to beyond Walk Hill Street on the south side of Forest Hills. The northern boundary extends from the Bromley-Heath project area along Heath Street at the foot

of Mission/Parker Hill to the Jamaicaway. The western boundary is the Jamaicaway and Centre Street and includes the Arnold Arboretum area and Moss Hill. East of the Arboretum and south of Forest Hills are several residential areas which blend into Roslindale. The northern portions of these residential areas focus on Forest Hills as a commercial and transit center and are usually considered within Jamaica Plain. The eastern boundary is the cemetery and Franklin Park open space up to Seaver Street. The boundary then follows Seaver to Egleston Square and then Columbus Avenue to return to Jackson Square.

Within this general area are a number of neighborhoods of widely varying age, physical form and socio-economic structure. A sampling to suggest the range of conditions is as follows:

- The Bromley-Park-Heath Street public housing projects. Age 20 to 30 years, 3-story walk-up and elevator high-rise.
- Our Lady of Lourdes parish area. Two- and three-family houses, many owned within a family for two or three generations.
- An institutional area along South Huntington Avenue and including the V.A. Hospital.
- A strong pedestrian oriented commercial section along Centre Street reinforced by a street running trolley.
- A grouping of elderly housing and nursing homes in the Jamaica Pond and Sumner Hills areas. These generally are large, wood-frame houses converted for institutional use.
- Early Twentieth Century large single-family houses along the Jamaicaway and Arborway. These are largely owner-occupied, although many have been subdivided into two or three units.
- Moss Hill is generally suburban in character and was developed between the mid-twenties and early sixties. Incomes and property values are among the highest in the City of Boston.

While these descriptions are very general and not all neighborhoods are included, they show the very great range of social and physical diversities. Unlike the South End where differing socio-economic groups occupy similar structures and live in close proximity, Jamaica Plain neighborhoods are distinctly different in physical as well as socio-economic character and frequently are separated by strong physical boundaries. Thus, there is rarely a Jamaica Plain-wide consensus on a critical issue. Most issues do not affect or interest more than one or two neighborhoods at a time. Jamaica Plain is often taken as a measure of voting patterns of the entire City of Boston because of its balanced composition and historical parallels in this regard.

Recent population movements have transformed some of the eastern and northern precincts into neighborhoods of populations which are racially and ethnically mixed. A mixture of residential and industrial land uses parallel the rail tracks from Jackson Square to Forest Hills. Wide variations exist in the scale and present condition of the housing and industries which border or remain adjacent to the rails.

There are several specific problems closely related to existing transit services within Jamaica Plain:

- The Washington Street elevated structure creates a conflict between automobiles, pedestrians and transit facilities throughout its length.

It is, perhaps, best represented by the chaos created at Forest Hills, which contains a concentration of commercial facilities closely related to the transit terminus in an environment hostile to both pedestrians and autos. Auto-pedestrian conflicts seem to characterize the portions of Jamaica Plain adjacent to the rail lines. Motorists seeking to bypass Washington Street because of its elevated line obstacles flow through heavily residential streets. Lamartine Street from Boylston Street to Green Street is an example of an attractive residential street overburdened with through traffic. Washington Street therefore continues to fail in its functions to carry traffic. The result is that businesses along its length have been forced to abandon the street to avoid the difficulties it presents.

- The Arborway streetcar line runs along Huntington Avenue, then south along Centre Street and South Street to Forest Hills. The absence of a reserved right-of-way presents severe operational problems to the MBTA and frustrates traffic flow. In spite of these problems the neighborhoods have voiced a strong desire to maintain and upgrade trolley service rather than change to bus service.

- Bus stations at Egleston Square and Forest Hills are unattractive and present environmental and traffic problems.

- The interconnections between bus, Green Line and Orange Line at the Arborway and Forest Hills are split between two locations rather than one. Both facilities (because they are in split locations and are in poor physical condition) contribute to lowering the level of service.

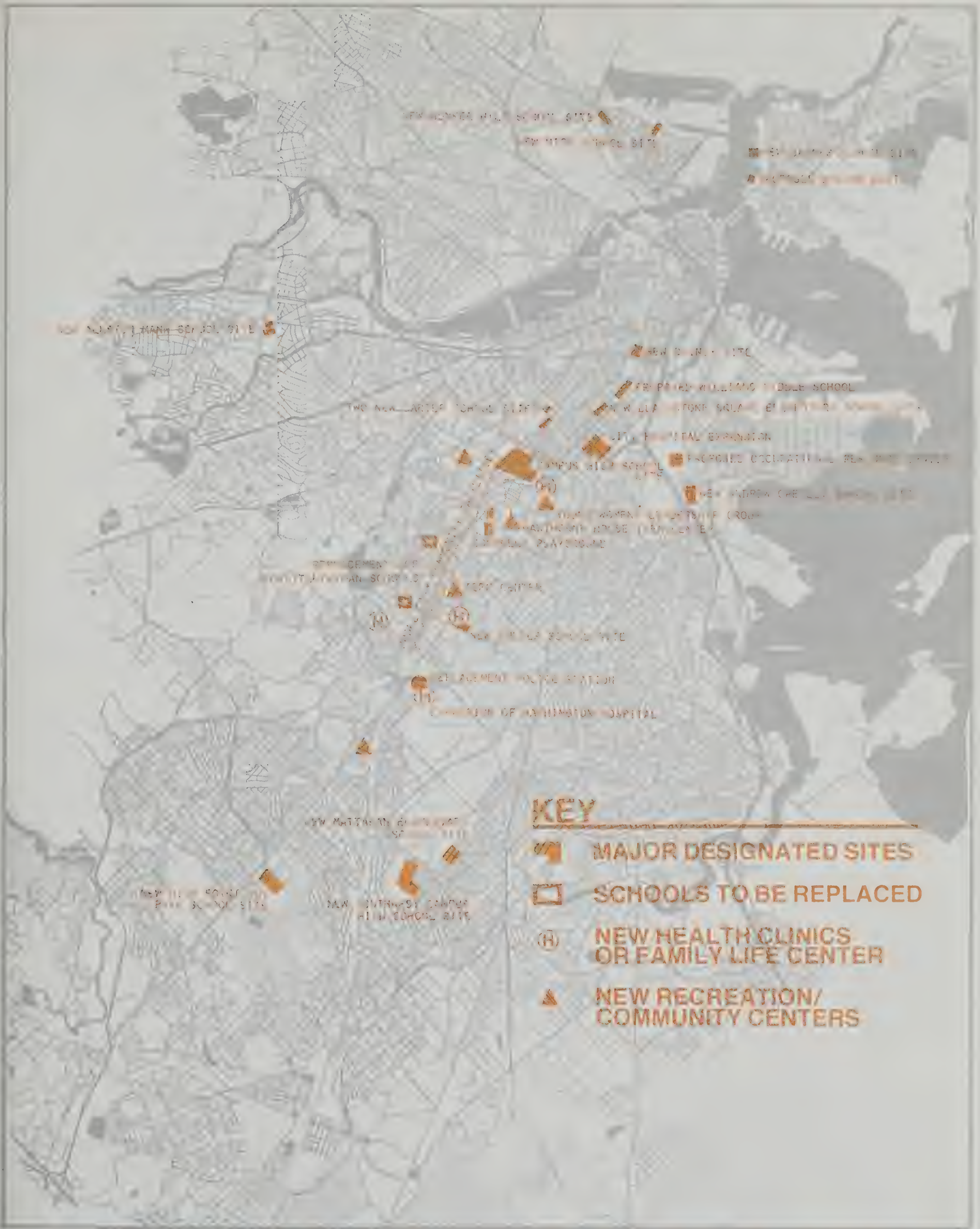
- Route 1 bus and truck traffic is excluded from the Jamaicaway, an MDC auto-only parkway. As a result through traffic filters through local service arterials and impacts on residential and local retail areas.

Jamaica Plain, compared with other inner-suburban neighborhoods, has many environmental and cultural advantages. Its attractiveness as a residential neighborhood is reduced, however, by several negative environmental factors, by noxious and conflicting land uses (especially along the rail corridor), and by antiquated or inadequate city facilities and services. As a result, its future development is perceived to be doubtful by residents and non-residents alike.

2.2.2.2. Community Facilities

The community facilities in progress in the study corridor are shown in Fig. II-7. The proposed alternatives do not require the taking of any community facilities beyond existing Department of Public Works property holdings. Within those holdings, the Third Nail Drug Rehabilitation Center and the Jamaica Plain Area Planning Action Council lease space on a 30-day revokable basis. Several federally sponsored renewal programs (Model Cities Sub Areas 1 and 2, the Campus High, Fenway and South End Urban Renewal Projects) abut the Corridor. Nevertheless, designation of this area, first for a highway and later for mass transit and arterial street improvements, precluded siting of new community facilities within the D.P.W. holdings.

Undoubtedly the takings and continued indecision about re-use of Corridor land has negatively impacted facilities closest to it. Declining service population and an uncertain context for expansion, capital improvements or future locational strategy has had its effect. The decision against an Interstate Highway and in favor of mass transit and redevelopment provides a clearer framework for planning and decision making. Because it is adjacent to an impressive number of regional and local institutions, the Corridor represents increased access and modal choice. The



COMMUNITY FACILITIES IN PROGRESS

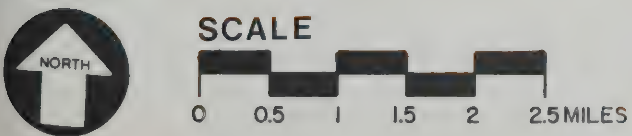


FIGURE
II-7

cleared land resource presents a number of sites suitable either to expand existing community facilities or to site new ones. A feasibility study is now underway for the use of land between Jackson Square and Roxbury Crossing as the principal site of the Roxbury Community College.

Discussions with various City officials indicate that Corridor-Land could provide for immediate and long-range public facility needs. Although some are very tentative, city facilities which could be located in the Corridor include: a replacement for the Bowditch-Wyman Elementary School and the District Police Station in Jamaica Plain; the outmoded Police stables south of Forest Hills; the Fuller Elementary School in Roxbury and additions to the Carter School Playground site in the South End. In addition, vacant or underutilized warehouse space near the Corridor might be used to accommodate city warehousing functions currently located in a former public school in the St. Botolph Street Area. Reassigning that use to a suitable structure in or near the Corridor potentially frees that school for use as a much needed community facility in that neighborhood.

Open space planning for the Southwest considers the establishment of a bicycle and pedestrian oriented path linking parks, playgrounds and community facilities throughout its length.

Although originally conceived as a linear trail with lateral connections at Forest Hills and Ruggles Street only, analyzing the existing pattern of open space and community facilities suggests the exploration of additional lateral connectors. In Jamaica Plain the planned Southwest II High School and the existing Agassiz Community School and Saint Thomas High School and Church, point to the importance of the pedestrian environment along Childs and Williams Streets. Strong parish ties indicate similar consideration in the Boylston Street area.

In Roxbury, Highland Street and Martin Luther King Blvd., potentially link the Bromley Heath Housing Project and the Hennigan Community School to the Shellburne Recreation Complex, the Roxbury YMCA, the Boys Club and Boston Technical High School. Historic John Eliot Square and Dudley Station represents another linkage possibility. The Symphony, the Christian Science Center, the Harriet Tubman Center and City Hospital Complex all located along Massachusetts Avenue provide the context for a strong, coherent visual connection between them, keyed by the projected Massachusetts Avenue station.

2.2.2.3. Current Land Use and Zoning (Fig. II-8)

Predominant land use in the project area is residential. It is of higher density (high-rise) at the northern edge of the Corridor in the South Cove, and of lower density (single-family, duplex and three deckers) as the Corridor approaches Forest Hills to the south. However, high-density publicly supported housing developments are located at several locations immediately adjacent to the Corridor.

Local business districts are interwoven with the residential areas and are generally of the corner store or strip commercial variety. Larger aggregations of retail activity in the area are exceptions. Dudley Square is the largest of this type. Other concentrations of retail activity are at Egleston Station, Green Street, and Forest Hills in Jamaica Plain. Lying further from the Corridor are the Central Business District and the Prudential Center Area in Back Bay.

Manufacturing and industrial activity are located adjacent to the railroad right-of-way and the proposed arterial alignment. The greatest concentration of such uses are found at the ends of the Corridor, in the South Bay Area near City Hospital and at Forest Hills.

A number of public institutions are located near the cleared Corridor in the vicinity of Ruggles Street and Roxbury Crossing. These include the Museum of Fine Arts, Northeastern University, Boston State College, Wentworth Institute, Peter Bent Brigham Hospital and many others. Other institutional complexes are Boston City Hospital at Massachusetts Avenue and the New England Medical Center in the South Cove. Although strong tension continues between the institutions and local communities who resent encroachment on their territories, these institutions have a continuing interest in the decisions on the Relocated Orange Line and even more concern about the use of certain lands for their expansion programs adjacent to the line.

Public open space usage adjoins the Corridor: the Fenway at Ruggles Street and Franklin Park and the Arnold Arboretum near Forest Hills.

The most significant characteristic of the Corridor is cleared land. The scale of demolition for highway construction plus the uncertainty as to an eventual decision about the highway has given the cleared strip a "wasteland" character. In Jamaica Plain most takings for the expressway were west of the railroad. Between Jackson Square and Ruggles Street most takings were on the east side of the tracks. From Ruggles Street, cleared land extends to City Hospital.

Before the land was cleared, its use in the immediate corridor was a mix of manufacturing uses (including several industrial areas having rail sidings) with housing interspersed. Much housing was cleared in Lower Roxbury. This has been replaced in the past five years by developments utilizing federal and state assistance.

The Penn Central tracks are located on an earth embankment. Due to its imposing size and narrow openings, the embankment looms as a major physical barrier between communities. It is significant, however, that the predominantly industrial uses existing adjacent to the embankment prior to demolition may have contributed to this sense of community separation.

Current zoning in the project area corresponds very closely to current uses. Much of the cleared land is currently zoned for manufacturing.

2.2.2.4. Federally-Assisted Programs

Several federally-assisted programs are now underway for much of the land abutting the rail corridor (see Fig. II-9). These include the Model City Program, which is coordinating a number of social, economic and physical development programs in six sub areas. Of the construction projects within the Model Cities area, very few abut the Corridor directly. One exception is the elderly housing development on the Holzer-Cabot property south of Jackson Square. Community programs such as the Third Nail drug rehabilitation effort, and the Jamaica Plain Area Planning Action Council (APAC) now lease DPW-owned property within the Model Cities area on a 30-day revocable basis.

The Campus High School Urban Renewal Area is well into construction. A 2,500 student high school and 2,000 student occupation resources center are under construction in an area which abuts the cleared land. The area in question is located between Ruggles Street and Roxbury Crossing. This project includes the Lower Roxbury Community Corporation housing units, several hundred of which have been completed and are being occupied.

The South End Urban Renewal Area is bounded on the west and north by the project Corridor. Back Bay sites and projects likely to be affected by the Relocated Orange Line are concentrated in this renewal area. The proposed new arterial construction in the presently cleared land abuts the South End Urban Renewal Area at its southern boundary.

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PROJECT AREA

EXISTING LAND USE MAP

LEGEND

- OPEN SPACE
- INDUSTRY
- INSTITUTIONAL
- BUSINESS
- CLEARED LAND
- RESIDENTIAL

NORTH

SCALE

0 1200 2400 3600

FIGURE

II-8

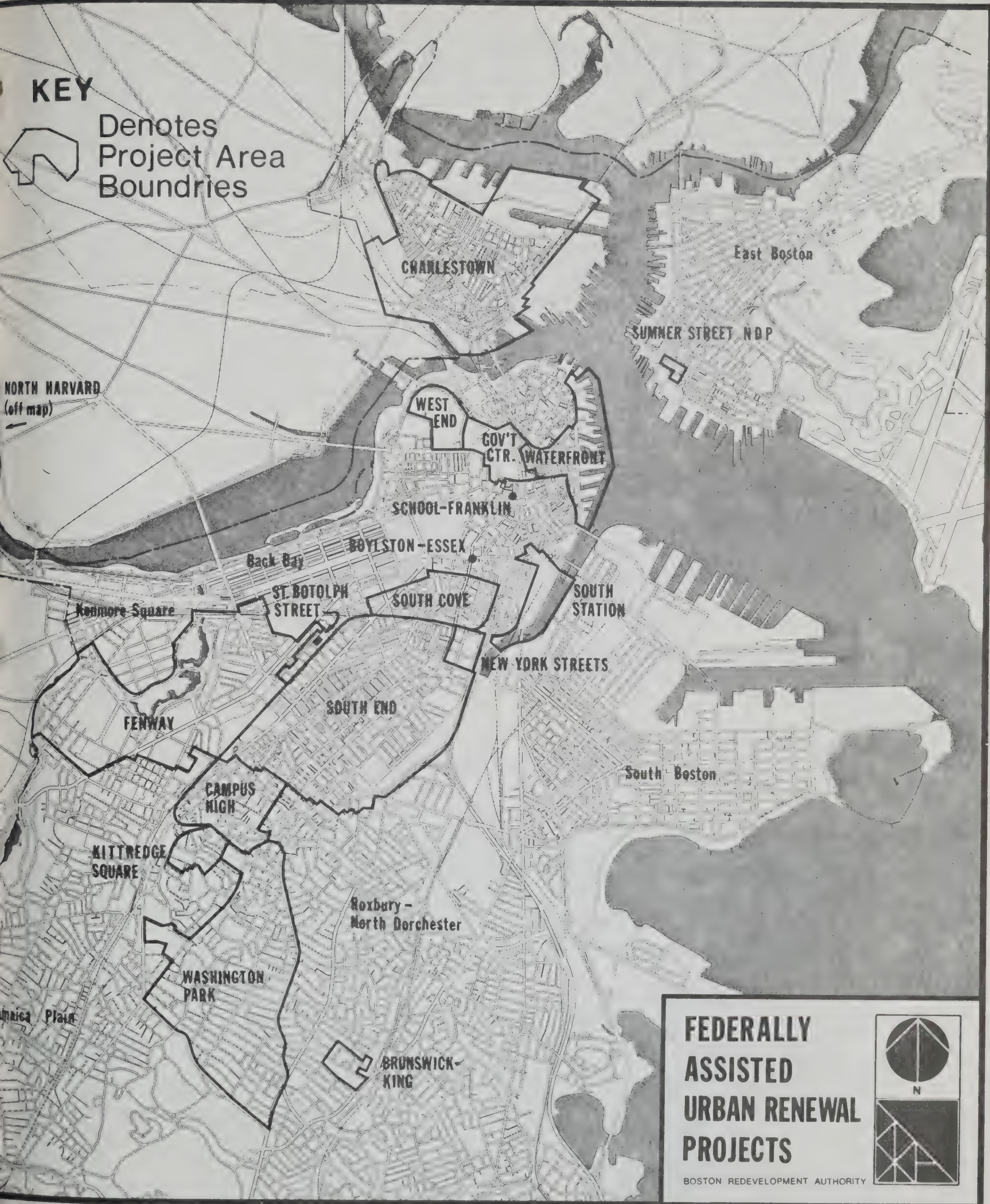

KEY
Denotes Project Area Boundries
CHARLESTOWN
East Boston
SUMNER STREET NDP
NORTH HARVARD (off map)
WEST END
GOV'T CTR.
WATERFRONT
SCHOOL-FRANKLIN
BOYLSTON-ESSEX
Back Bay
ST. BOTOLPH STREET
SOUTH COVE
SOUTH STATION
Kenmore Square
NEW YORK STREETS
SOUTH END
FENWAY
South Boston
CAMPUS HIGH
KITTREDGE SQUARE
Roxbury - North Dorchester
WASHINGTON PARK
Plain
BRUNSWICK-KING
N
FEDERALLY ASSISTED URBAN RENEWAL PROJECTS
BOSTON REDEVELOPMENT AUTHORITY

FIGURE II-9

The remaining urban renewal areas adjacent to the Corridor are the Fenway Project and Washington Park. The Fenway Area plan includes three vacant parcels and one renewal parcel at Massachusetts Avenue adjacent to the railroad. Washington Park is a project area which is substantially complete and does not directly abut the Corridor. However, Martin Luther King Boulevard was constructed in the east-west direction within the Washington Park area and is projected to extend to Jackson Square. It could affect local street traffic and transit service in the Corridor by providing increased vehicular access.

The Corridor is characterized by one of the City's most significant concentrations of public and subsidized housing. Orchard Park, Whittier Street, Mission Hill and Bromley Heath public housing projects abut the Corridor. If projects within two or three blocks of the Corridor are included, there is an estimated public housing population of at least 15,000 persons within the Corridor area. Publicly subsidized housing recently constructed include Academy Homes, various South End Urban Renewal housing sites, and the Lower Roxbury Community Corporation housing within the Campus High School Renewal Area. Many of the more recent developments are subsidized federally utilizing the vehicle of the Massachusetts Housing Finance Agency.

2.2.2.5. Proposed Land Use and Planning

Changes in current land use would occur at transit/rail station locations and in the cleared land areas. These would generally consist of converting land formerly devoted to manufacturing uses to residential, commercial (retail), institutional, or open space uses. One segment of the Corridor (from Dudley Station to City Hospital) is being proposed for strengthening of the manufacturing uses currently located there. Section 7 of this study devotes itself to a detailed description of proposed uses in the Corridor on a parcel-by-parcel basis.

Open space planning is also an important aspect of this study document. Proposals are made to reinforce the existing open space network and to furnish amenity to the transportation elements that are the subject of this report.

All land-use planning and open-space planning has been accomplished with the help of the various neighborhoods involved and impacted.

2.2.2.6. Open Space

The Southwest Corridor, because of its long linear configuration, interfaces parks and playgrounds of many varieties between Forest Hills and the South Cove Area. Relatively little parkland actually falls within project boundaries, but the fact is that the Corridor runs so close by, that it has implications for these existing open spaces.

In addition to its proximity to local parks and playgrounds, the Corridor closely parallels elements of the historically significant Olmsted Park System.

The Olmsted-design Boston Park System which became a model for park planning throughout the country, includes the Back Bay Fens, the Fenway, the Riverway, the Jamaica Way and Jamaica Pond, the Arboretum and Franklin Park. All of them are within walking distance of the Corridor. John Eliot Square in Roxbury, the Christian Science Center in the Fenway Area and Copley Square in Back Bay are significant urban open spaces. They are also within a short walk from the Corridor.

Close examination of the adequacy and distribution of open space resources in the vicinity of the Southwest reveals an interesting contradiction. Using the City of Boston goal (10 acres of open space per

thousand population divided between local and regional facilities)* as a measure, it is clear that Corridor neighborhoods are well served by regional facilities but lacking in local open-space amenities. This deficit is especially apparent near the Bromley-Heath and Mission Hill public housing projects and in the Boylston Street area of Jamaica Plain. In these areas limited facilities exist for older children and young adults. Very little is available for smaller children and infants.

Nearby community facilities will be taken up in more detail later. Their locations, however, their adequacy and the populations they serve have important implications for possible uses of Corridor land. As a case in point, there are several existing schools whose play facilities do not meet modern standards for school construction. There are other new schools planned for the area, but they are in densely built neighborhoods on small sites which could benefit from expanded site opportunities.

It is against this background of historic precedent, open space deficits and location pattern of parks, playgrounds and public facilities that a framework for Corridor-wide open space planning has emerged. The rare occurrence of so much cleared land, between Forest Hills and Massachusetts Avenue, stretching through so many neighborhoods provides the opportunity to develop a nearly continuous path from Franklin Park and the Arboretum at Forest Hills to Copley Plaza and beyond. This spine can serve both a linking function between open spaces, community facilities and places of interest and can provide, within it, open space activities of infinite variety.

While a linear network of linkages is an obvious opportunity, certain lateral linkages appear desirable also. The most important perhaps is the restoration of a direct connection between Franklin Park and the Arboretum which currently has been destroyed by the complicated system of ramps, streets and viaducts which characterize Forest Hills. Other important lateral linkage opportunities include pedestrian and bicycle connections to facilities along Martin Luther King Blvd., an open space link between the Fenway, the New Campus High School complex and the City Hospital complex, pedestrian-oriented connections to Symphony Hall and the Christian Science Center and to the developing Dartmouth Street Mall.

It will take vision, insight and cooperation from the critical agencies and departments, but with adequate funding, a system of safe and pleasant paths, can connect local and regional parks, the Symphony, the Museums, Fenway Park, the National Museum of Afro-American Artists and many other amenities throughout the Southwest area. An aggressive, innovative and coordinated approach to the design of Southwest open space can result in a visual and functional continuity. It would have positive benefits to the Boston community at large for many years to come.

2.2.2.7. Population and Housing

The Southwest Area population is decreasing, as may be seen in Fig. II-10. During the period from 1960 to 1970, the Inner City communities experienced dramatic declines in population, greater than that for the Southwest Subregion as a whole. The Inner City communities, including those in the vicinity of the proposed project, had population declines of 13.3 percent. The South End and Roxbury, for example, had decreases of over 25 percent.

The decentralization trends of population which have been occurring in Boston during the past 20 years were somewhat accelerated by public actions in the Inner City, most notably by considerable building demolition

*Source: "Open Space in Boston-Goals and Policy Recommendations", BRA, December-January, 1971-1972

involved in urban renewal and highway projects in South End and Roxbury. Due to the lengthy process between original displacement and reconstruction of housing units, these projects caused some of the residents to move, not only out of the community, but out of the city as well. Other public actions, including the acquisition for the expressways in the Southwest Corridor, also hastened the decline in population in the Inner City areas.

The racial composition in the Inner City area has undergone major change since 1960 with increases in black and Spanish-speaking families. Over 90 percent of the non-white population in Boston lives in the Southwest. In 1970, 16 percent of the total City population and 27 percent of that in the southwest communities were black. Black population increased in all localities except the South End. However, due to a much larger decline in total population, the proportion of blacks in the South End increased as a percentage of the total population. The proportion of non-whites to white population increased in all communities, most notably in Roxbury. In Roxbury, increases in the percentage of non-white population were due primarily to an out-migration of whites, reflected both in overall population decline and a relatively small increase of non-whites.

Fig. II-10 and Fig. II-10a shows the areas which experienced change in population between 1960 and 1970. Project area communities, despite an overall decline in population, still maintain the characteristic high density associated with older Inner City areas (see Fig. II-10b). Overall density levels have stabilized somewhat, particularly in the large areas of new housing construction and rehabilitation in South End, Roxbury, and portions of the Fenway. In some deteriorated areas where public projects have not been effected, high vacancy rates have appeared and have lowered the overall density of population.

Between 1960 and 1970, total housing units decreased in the City of Boston relative to population in the South End, Roxbury, and the Fenway. In Fenway and South End, population per occupied unit increased. During the same period, the number of persons per unit decreased in Roxbury, perhaps indicating a loss of larger units. The number of total units increased slightly in the Central Area, Jamaica Plain, and Back Bay. More substantial increases occurred in Roslindale, Hyde Park, West Roxbury, and South Dorchester.

Fig. II-11 shows comparisons of 1960-1970 housing characteristics in the Souhtwest Corridor. With the exception of Hyde Park and West Roxbury the overall vacancy rates increased from 1960-1970, despite a loss in total units. Highest vacancy rates occurred in South End and Roxbury. (See Fig. II-11a for major housing locations.)

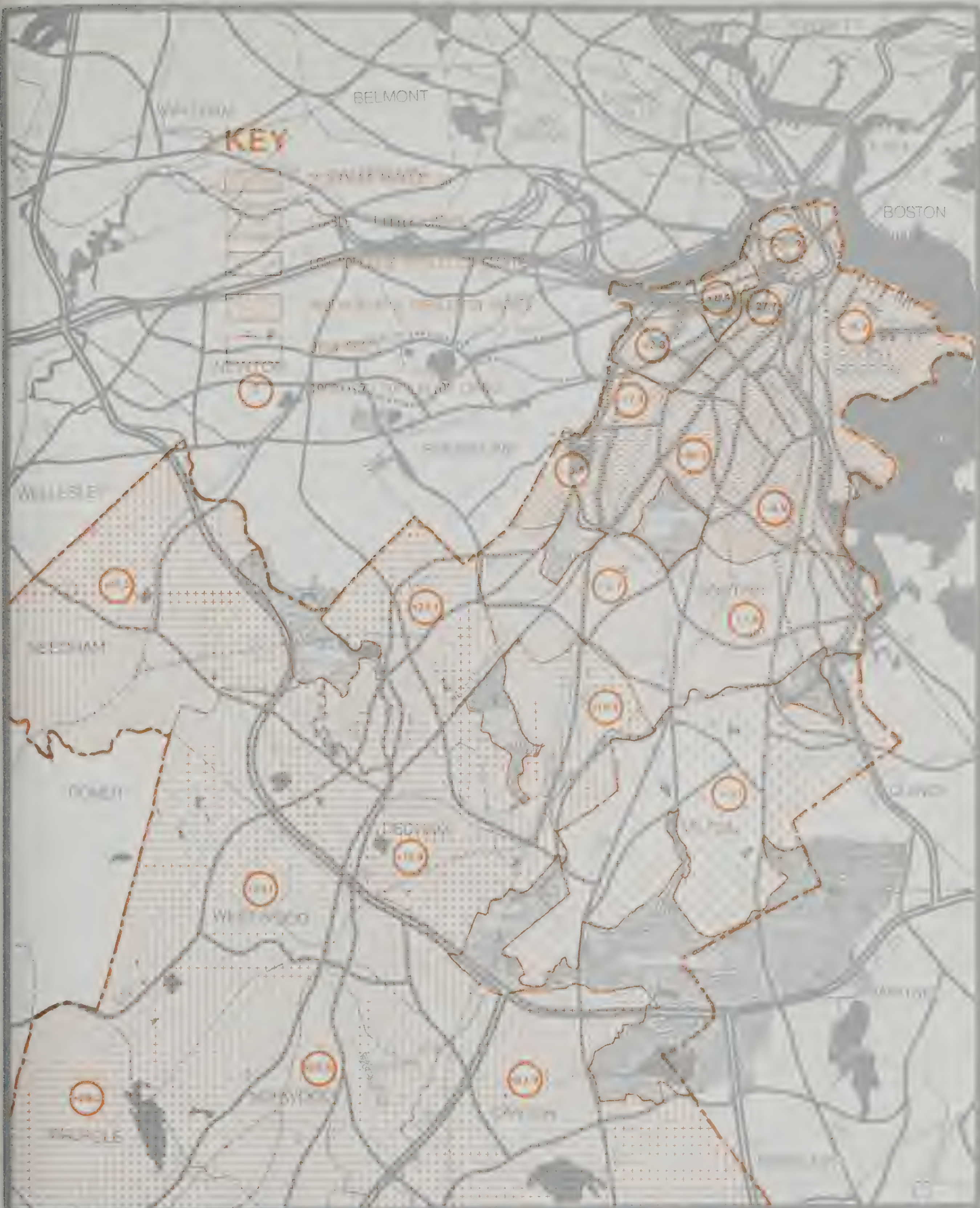
The characteristics of housing stock in Boston also changed in the last decade with the number of single-family decreasing at a more rapid rate than total units. This is particularly true in the South End where single-family homes decreased by 69 percent, compared to 43 percent decline in total units. Single-family homes account for 30 percent of total stock in Southwest Boston, while 56 percent of all units are renter-occupied. Thus, at most, only half of owner-occupants live in one-unit structures. By contrast, virtually all owner-occupants in the Southwest localities outside Boston live in single-family homes.

Renter-occupied units increased at a greater rate than one-unit structures in those Southwest Boston communities where there were increases in total units. The only exception was South Dorchester. West Roxbury evidenced the largest increase in total units or 33 percent. Its renter-occupied units increased by 139 per cent, compared to a 10 percent increase in single-family homes. Median rent (gross housing costs per month) increased from $80 in 1960 to $105 in 1970, a change of 31 percent. Greatest increases were in the South End and the Fenway. The lowest rates of increase occurred in North Dorchester, and Mattapan.

SOUTHWEST SUBREGION WITHIN BOSTON CITY LIMITS (Fig. II-10)

	Population Characteristics:				Income Characteristics: Individuals:			Families:		
	Population 1960	Population 1970	Percent Change 1960-1970	Percent Black 1970	Below Poverty	Total	Percent	Below Poverty	Total	Percent
Inner City										
South End	30,059	21,726		46.6	3,170	8,855	36	790	3,629	22
Back Bay	47,869	51,912		9.1	8,086	39,474	21	536	4,938	11
Fenway	(23,014)	(23,551)		(14.8)	(3,793)	(17,207)	(22)	(361)	(2,442)	(15)
Roxbury	85,194	62,856		65.2	3,597	10,314	35	3,102	13,825	22
Mission Hill	(23,137)	(19,144)		(28.6)	(1,907)	(4,960)	(38)	(857)	(3,820)	(22)
South Boston	45,766	38,488		1.0	1,600	5,210	31	1,230	9,115	14
Jamaica Plain	35,372	33,060		4.1	1,046	4,284	24	769	7,925	10
North Dorchester	112,504	101,386		33.0	2,579	8,492	30	4,133	23,605	18
Subtotal	356,764	309,428	-13.3	29.4	22,747	88,100	26	11,033	68,347	16
Inner Suburbs										
Roslindale	40,363	40,070		1.8	702	2,670	26	517	9,994	5
South Dorchester	74,135	75,505		20.1	1,781	6,287	28	1,744	18,983	9
Hyde Park	33,123	38,264		1.4	692	2,336	30	518	9,653	5
West Roxbury	25,328	31,190		.3	513	2,209	23	273	8,025	3
Subtotal	172,949	185,029	+ 7.0	8.9	3,688	13,502	27	3,052	46,655	7
TOTAL	529,713	494,457	- 6.7	21.7	26,435	101,602	26	14,085	115,002	12

Source: BTPR



1960-1970 GROWTH POPULATION & DECLINE

SOURCE: BTPR

NORTH

SCALE

0 1 2 3 4 MILES

FIGURE II-10a

1970 SOUTHWEST POPULATION DENSITY

SOURCE: BTPR

NORTH

SCALE

0 1 2 3 4 MILES

FIGURE II-10b

(Fig. II-11)

SOUTHWEST CORRIDOR HOUSING CHARACTERISTICS

	1960 Housing Units	1970 Housing Units	Percent Change 1960-1970	Percent Multi-Fam. 1970	Percent Renter Occupied 1970
(Boston)	(238,545)	(232,413)	(-2.6)	(89.9)	(68.2)
Inner City					
Central Area	14,797	14,847	+ .3	96.6	75.2
South End	18,264	10,358	-43.3	92.1	74.3
Back Bay	22,327	23,136	+ 3.6	98.3	89.6
Fenway	(11,389)	(10,842)	(- 4.8)	(91.1)	(91.0)
Roxbury	29,400	23,356	-20.6	90.0	74.7
Mission Hill	(7,092)	(7,357)	(+ 3.7)	(95.5)	(80.5)
South Boston	14,575	14,259	- 2.2	86.3	69.5
Jamaica Plain	10,969	11,155	+ 1.7	83.5	65.9
North Dorchester	34,145	32,525	- 4.7	91.1	66.7
Subtotal	144,475	129,636	-10.2	91.7	74.1
Inner Suburbs					
Roslindale	10,831	12,307	+13.6	66.6	48.6
South Dorchester	22,072	24,599	+11.4	81.5	59.1
Hyde Park	9,292	11,880	+27.8	49.9	43.1
West Roxbury	7,365	9,827	+33.4	41.7	33.6
Subtotal	49,560	58,613	+18.2	65.3	49.4

Source: BTPR

Despite a large rate of increase in 1970, median rent, at $86 per month, was lowest in the South End. In 1960, the South End also held the low median monthly rent of $49 per month. Median rents of $123 to $143 per month in West Roxbury, Fenway, and Hyde Park were highest.[1]

Significant housing developments built in the period 1960-1970 which are located near the Corridor are listed below.

Prudential Center	Back Bay	781 units
Castle Square	South End	602 units
Back Bay Manor	Mission Hill	298 units
Charlesbank Apartments	Mission Hill	257 units
Back Bay Towers	Mission Hill	146 units
Academy Homes	Roxbury	515 units
Forest Hills Apartments	Jamaica Plain	195 unts

Many housing developments have been constructed since 1970. The early 1970's was a period of substantial real estate activity although more recently there has been a significant showing of construction of all types. A considerable amount of this activity has been by smaller or individual owners who have rehabilitated existing residential units in the South End, Back Bay, Roxbury, and Jamaica Plain either for the private or subsidized market. The Massachusetts Housing Finance Agency has financed many of these developments as well as larger new construction housing developments. The Back Bay has experienced a surprisingly large number of condominium conversions.

The following is a tabulation of significant housing developments located near the Corridor and constructed since 1970.

Tai-Tung Village	South Cove	224 units
Mass Pike Towers	South Cove	198 units
Parcel R-4 (abuts Quincy School)	South Cove	150 units (under Construction)
Roxse House	South End	364 units
Westminster E. William Place	South End	279 units
Methunion Manor	South End	150 units
Camfield Gardens[2]	South End	135 units
Piano Craft Guild (rehab.)	South End	174 units
West Newton St.[2] (rehab.)	South End	136 units
Church Park	Fenway	508 units
Garrison (St.Botolph St.)	Fenway	134 units
Mission Park	Mission Hill	775 units (under construction)
125 Amory Street	Jamaica Plain	234 units
Forbes Bldg.	Jamaica Plain	147 units (under construction)
Smith House	Roxbury	132 units
Haynes House	Roxbury	131 units

Currently there are two significant housing proposals near the Corridor which are in the processing stage.

Symphony Towers (Mass. Avenue at Huntington Avenue)	Fenway	400 units
Madison Park Townhouses	Roxbury	120 units

[1] All Preceeding Housing Data was obtained From the BTPR-Southwest Report, September, 1972.

[2] As of March 1, 1974 there were 1912 conventionally financed rehabilitated units of a total of 3406 rehabilitated units in the South End. (Source: BRA)

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PROJECT AREA

MAJOR HOUSING LOCATIONS

LEGEND

- ● HOUSING DEVELOPMENT 1960–1969
- ■ HOUSING DEVELOPMENT 1970–1976
- ▲ EXISTING PUBLIC HOUSING

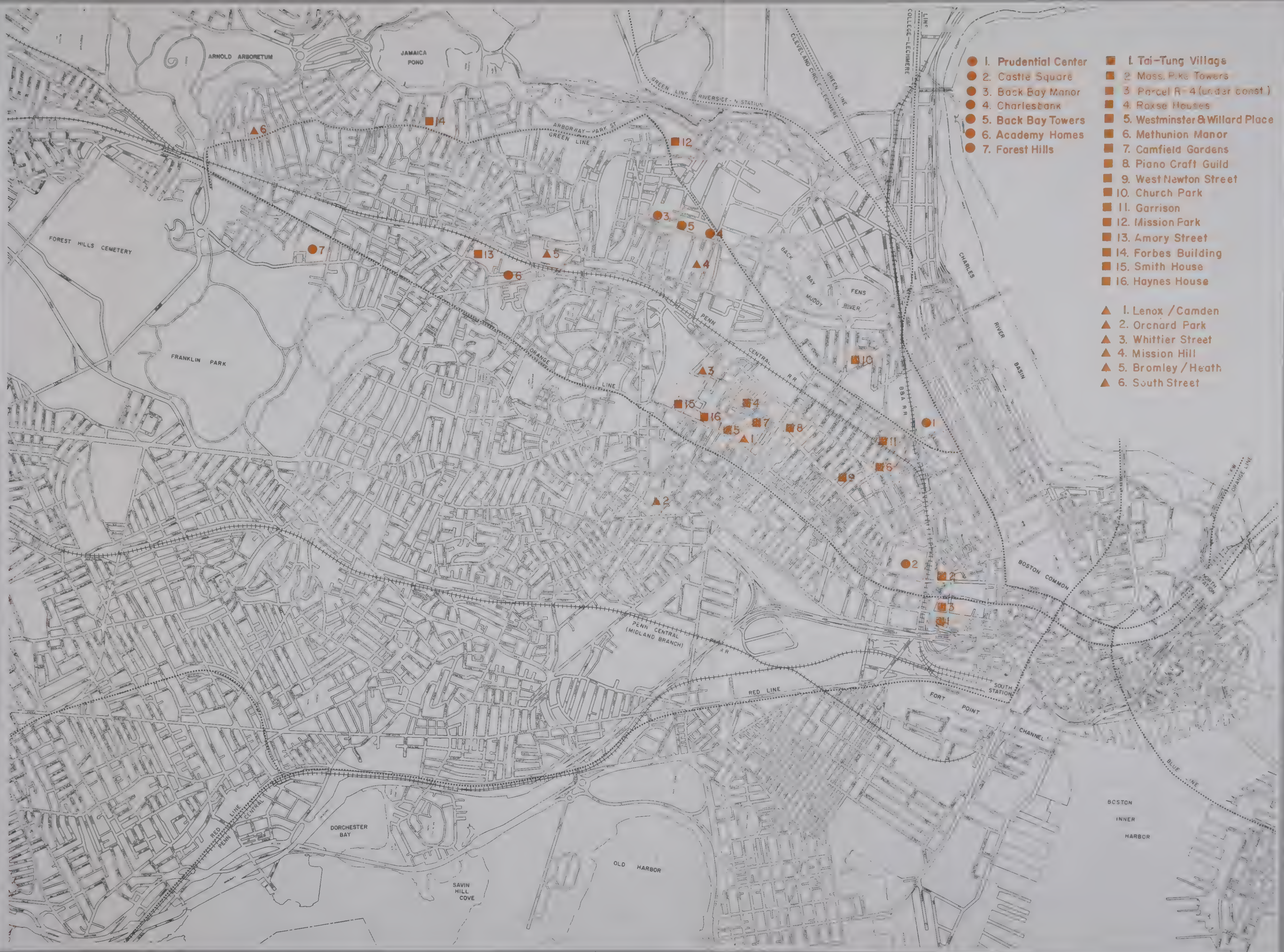
SCALE

NORTH

0 1200 2400 3600

FIGURE

II-11a



MAJOR HOUSING LOCATIONS

2.2.2.8. Economic Characteristics.

The Boston region is now acquiring the characteristics of a maturing economy. It has a slow growth rate and a shift from a manufacturing to a service base. While this trend toward service employment conforms to that of the national economy, Boston exhibits it more strongly than other metropolitan areas. In fact, Boston is a national leader in the provision of some basic service, such as finance, management, education, medicine and related research. At the same time, however, Boston has sustained an absolute decline in the manufacturing sector.

In spite of a decline of manufacturing jobs in the metropolitan area and a decentralization trend, it is singificant that over two-thirds of the regional manufacturing jobs are located within two miles of Boston City Hall in downtown Boston and in the communities of the South End, South Boston, North Dorchester, East Boston, and Charlestown. Concentrations of manufacturing jobs in cities such as Cambridge and Somerville also reinforce the importance of the regional core as a major employment center for blue collar jobs. Other manufacturing job opportunities influencing the southwest area are located outside Boston, in Quincy, and other suburban communities around Route 128. Except for a concentration of manufacturing and wholesaling employment in Readville (Hyde Park), the remaining portions of Southwest Boston account for less than 15 percent of the total manufacturing employment.

The changes in composition of industries and in each industry's employment requirements are having an impact upon the employment structure of the metropolitan area and consequently on economic mobility and opportunity. Fig. II-12 shows the 1967 through November 1975 structure of employment in the Boston SMSA.* Over the time period covered, the Boston area has lost employment in manufacturing at a rate of 2 percent per year. Note also the sharp downturn in construction and transportation employment since 1971. Fig. II-13 focuses on the employment characteristics of those communities in the southwest section of the metropolitan area. Note that between 1960-1970 occupation fields which exhibited significant growth were in the professional, clerical, and service areas.

The least growth is in the operative workers and craftsmen categories, with managers and sales workers showing only slightly greater growth. This change in occupational structure suggests that job opportunities in the future may center more upon professional and clerical job categories, implying higher levels of required training. Further, this occupational structure may impose problems for persons who do not easily achieve professional training and status, especially women and members of minority groups.

The Southwest Section of the metropolitan area contains the greatest concentration of the region's lower-income, minority population. They are heavily concentrated in the Inner City portions of Boston, including the project Corridor. This section has been losing population and gaining some jobs, but it still has the highest unemployment, the lowest incomes and among the area's poorest housing conditions. Comparative income levels in the Southwest communities of Boston as shown in Fig. II-14 include the percentage of those considered to be below the poverty level. Information on the inner and outer Southwest suburbs is included to show the dramatic differences in income distribution within the Corridor.

Although the percentage of individuals with lower income is basically the same throughout the Corridor, the Inner City includes a substantially higher percentage of families below the poverty level. In terms of absolute numbers, the Inner City contains far more persons and families below the poverty level than the inner or outer suburbs. Individuals below the poverty level in the suburbs are much more likely to be elderly than are those in the City where only one-third of the individuals below the poverty level are over 60 years of age.

*SMSA = Standard Metropolitan Statistical Area
(includes 17 cities, 61 towns)

(FIG. II-12)

EMPLOYMENT BY INDUSTRY DIVISION, BOSTON SMSA

Industry Division	Number of Employees (Thousands) 1967 (1)	1971 (1)	1974 (1)	Nov. 1975 (2)
Construction	50.2	58.5	54.6	51.3
Manufacturing	305.0	271.1	274.1	260.7
Transportation, Communications & Public Utilities	70.0	74.6	74.2	69.4
Trade, Wholesale & Retail	275.7	299.8	302.9	311.0
Finance, Insurance & Real Estate	84.4	95.1	98.7	100.0
Service, Misc. & Mining	278.9	286.3	319.2	337.4
Government	166.3	191.2	188.7	193.3
	1,230.5	1,276.6	1,312.1	1,323.1

Source: Massachusetts Division of Employment Security, Research and Statistics.

[1]Average annual employment

[2]Monthly employment

SOUTHWEST SUBREGION WITHIN BOSTON CITY LIMITS

1960-1970 Ocupational Characteristics by Community

(FIG. II-13)

	PROFESSIONAL, TECHNICAL, MANAGERS, ETC.		CRAFTSMEN, FOREMEN		CLERICAL - SALES		OPERATORS		SERVICE, HOUSEHOLD AND LABORERS		T O T A L	
	1970	% change 1960-1970	1970	% change 1960-1970	1970	% change 1960-1970	1970	% Change 1960-1970	1970	% change 1960-1970	1970	% change 1960-1970
Inner City												
South End	1,797	+21	725	-39	2,092	+14	1,598	-42	1,920	-61	8,132	-33
Back Bay	11,506	+33	946	-14	9,989	+25	1,222	-18	4,900	+33	28,563	+25
Fenway	(3,805)	(+13)	(466)	(+17)	(4,136)	(+19)	(623)	(-35)	(2,365)	(-29)	(11,395)	(+12)
Roxbury	4,212	+13	1,880	-36	5,519	+ 6	3,713	-53	5,797	-22	21,121	-22
Mission Hill	(2,076)	(+36)	(520)	(-28)	(1,962)	(- 5)	(704)	(-45)	(2,296)	(+25)	(9,528)	(+28)
South Boston	1,787	+15	1,748	-15	4,948	+16	2,435	-37	3,509	- 2	14,427	- 6
Jamaica Plain	1,989	-31	1,293	-24	3,098	-24	1,584	-39	2,493	+10	10,457	-23
North Dorchester	4,601	- 9	4,767	-22	10,841	-13	7,082	-25	8,543	+11	35,834	-12
Subtotal	25,892	+11	11,359	-25	36,487	+ 2	17,634	-37	27,162	- 8	118,534	-10
Inner Suburbs												
Roslindale	3,349	+ 5	2,126	- 6	5,613	+12	2,170	- 4	3,359	+37	16,617	+ 9
South Dorchester	5,523	+ 5	3,674	-11	10,920	+ 1	4,495	- 3	5,776	+52	30,388	+ 6
Hyde Park	3,247	+38	2,223	-46	5,507	+73	2,181	- 3	2,933	+50	16,091	+16
West Roxbury	4,029	+25	1,351	+14	4,887	+28	1,023	- 5	2,026	+55	13,316	+26
Subtotal	16,148	+15	9,374	-20	26,927	+18	9,869	- 3	14,094	+48	76,412	+12
TOTAL	42,040	+12	20,733	-23	63,414	+ 8	27,503	-28	41,256	+ 6	194,946	- 3

Source: 1970 Census Data. Those not reported, not included

Unemployment is probably the single most critical problem in the subregion. It is the inherent problem of an area with a high concentration of a low skilled, poor, disadvantaged minority. Language barriers are a further disadvantage for a large number of Spanish-speaking residents.

During mid 1975, a special survey of unemployment was conducted by the Massachusetts Division of Employment Security (MDES). The prime purpose of the survey was to develop unemployment estimates for all sections of the City of Boston. It showed an approximately 17 percent unemployment rate in Roxbury and in the South End.

"The sample represented only persons receiving total unemployment compensation benefits, but by inflating this sample to cover persons not receiving any form of compensation, an estimate can be developed for total unemployment. It should be noted, however, that a much larger percentage of black and Spanish-speaking persons are not eligible for unemployment due to inadequate earnings. Thus, a neighborhood like Roxbury or the South End would tend to have a much larger share of persons in total unemployment than projected from this study."[1]

Unemployment rates for 1970, for the 1975 MDES Study and the percent change, are shown in Fig. II-15.

Unemployment rate trends for the United States, Massachusetts and the Boston SMSA from 1970 to May 1975 are shown in Fig. II-16.

The severity of the subregion's unemployment problems is made clear by comparing Fig. II-15 with Fig, II-16. The rate in some communities is more than double that for the United States.

Demographic characteristics of unemployed persons surveyed by MDES in 1975 are shown in Fig. II-17 and Figure II-18. White males, 26 to 45 years of age show the highest percentage unemployed in predominately white communities such as Back Bay, South Boston, Roslindale, and Hyde Park. Black males of the same age group dominate the South End, Roxbury and South Dorchester.

The low percentages of Spanish males is undoubtedly due to the fact that large numbers of them were not eligible to be surveyed since they do not receive unemployment compensation.

Fig. II-19 reveals that an overwhelming number of unfilled job openings require a higher education (professional), special skills (clerical), special training (machine trades, bench work services) or union affiliation (structural work) -- all of which are beyond the reach of the residents of the subregion.

The Southwest Section of the Boston Metropolitan Area -- that area affected by the corridor development -- possesses most of economic problems characterizing the inner core of larger U.S. cities:

- Growing functional unemployment due to major shifts in the area's occupational structure;
- Growing structural unemployment owing to educational and other social barriers to upward shifts in job areas; and
- Growing number of families below the poverty threshold.

[1]Area Manpower Review - Boston Massachusetts SMSA (MDES, May, 1975)

(FIG. II-14)

INCOME CHARACTERISTICS*

	Below Poverty (1)	Total	Per-cent	Below Poverty (1)	Total	Per-cent
(BOSTON)*	(33,720)	(109,811)	(31)	(16,600	(142,019)	(12)
Inner City						
Central Area	2,669	11,471	23	473	5,310	9
South End	3,170	8,855	35	790	3,629	22
Back Bay	8,086	39,474	21	536	4,938	11
Fenway	(3,793)	(17,207)	(22)	(361)	(2,442)	(15)
Roxbury	3,597	10,314	35	3,102	13,825	22
Mission Hill	(1,907)	(4,960)	(38)	(857)	(3,820)	(22)
South Boston	1,600	5,210	31	1,230	9,115	14
Jamaica Plain	1,046	4,284	24	769	7,925	10
No. Dorchester	2,579	8,492	30	4,133	23,605	18
Subtotal	22,747	88,100	26	11,033	68,347	16
Inner Suburbs						
Roslindale	702	2,670	26	517	9,994	5
South Dorchester	1,781	6,287	28	1,744	18,983	9
Hyde Park	692	2,336	30	518	9,653	5
West Roxbury	513	2,209	23	273	8,025	3
Subtotal	3,688	13,502	27	3,052	46,655	7
Outer Suburbs						
Canton	160	665	24	96	4,088	2
Dedham	415	1,424	29	251	6,656	4
Foxborough	190	653	29	95	3,267	3
Milton	473	1,678	28	135	6,825	2
Needham	301	1,263	24	183	7,583	2
Norwood	462	1,877	25	238	7,540	3
Sharon	71	308	23	103	3,092	3
Walpole	133	737	18	123	4,178	3
Westwood	69	359	19	74	3,238	2
Subtotal	2,274	8,964	25	1,298	46,467	3
Total	28,709	110,566	26	15,383	161,469	10

*City totals for all Boston Neighborhoods

(1)Source: U.S. Bureau of Census, Money Income and Status of Families and Persons in the U.S. - 1974 (P. 60 Series, No. 99, July 1975). Weighted average poverty threshold for an individual in 1974 was $2,495/year and for a family of four was $5,038/year.

(FIG. II-15)

PERCENT OF UNEMPLOYMENT

	Percent Unemployment		Percent Change	
	1970[1]	1975[2]	1970	1975
Boston	4.5	14.1		
Inner City				
South End	7.2	17.9		149
Back Bay	3.9	7.6		95
Roxbury	6.1	16.7		174
South Boston	5.0	15.6		212
Jamaica Plain	4.3	17.0		295
North Dorchester	4.8	14.0		192
Inner Suburbs				
Roslindale	3.6	14.4		300
South Boston	3.5	15.1		331
Hyde Park	3.5	15.8		351
West Roxbury	2.7	11.7		333

Source: [1]Massachusetts Division of Employment Security (MDES); and U.S. Census

[2]MDES mid 1975 Special Survey

It should be noted that the 1975 rate and hence the percent change, should be viewed as indicators only. As discussed in the Review, the actual number of persons unemployed is larger than that projected from the Study. The 1970 U.S. Census ratios were utilized, which may not hold true today.

(FIG. II-16)

UNEMPLOYMENT RATE TRENDS

IN THE

UNITED STATES, MASSACHUSETTS AND BOSTON SMSA*

Period	United States	Massachusetts	Boston SMSA
1970	4.9	4.6	4.0
1971	5.9	6.6	5.7
1972	5.6	6.4	6.5
1973	4.9	6.7	6.8
1974	5.6	7.2	7.2
1975			
January	9.0	10.3	9.2
February	9.1	11.9	10.8
March	9.1	12.5	11.4
April	8.6	12.2	11.1
May	8.3	12.6	11.6

Source: Massachusetts Division of Employment Security

*Standard Metropolitan Statistical Area (Includes 17 Cities and 61 Towns)

(FIG. II-17)

Southwest Subregion Within Boston City Limits

Percent of Unemployment by Race and Sex

	Inner City	South End	Back Bay	Roxbury	South Boston	Jamaica Plain	N. Dorchester	Inner Suburbs	Roslindale	S. Dorchester	Hyde Park	W. Roxbury
W. Males		15	47	13	60	36	42		41	22	49	40
W. Females		10	22	4	38	25	22		33	12	35	39
Blk Males		23	10	45	0	12	11		0	30	2	1
Blk Females		12	3	19	0	7	5		1	16	1	1
Oriental Males		5	1	0	0	0	0		0	0	0	1
Oriental Females		15	3	0	0	0	0		0	0	0	0
Spanish Males		7	0	5	0	2	0		1	0	0	0
Spanish Females		1	0	4	0	2	0		1	0	1	0
Race INA* Males		24	8	8	1	9	11		11	13	6	11
Race INA Females		4	6	2	1	7	9		12	7	6	8

Source: MDES mid 1975 Special Survey

* Information not available

(FIG. II-18)

PERCENT OF UNEMPLOYMENT BY AGE GROUPS

	16-19	20-25	26-45	46-64	65+
Inner City					
South End	0	12	52	26	10
Back Bay	1	19	46	19	15
Roxbury	2	24	46	21	7
South Boston	3	16	28	32	21
Jamaica Plain	2	21	36	21	20
North Dorchester	2	19	36	25	18
Subtotal	2	20	40	24	14
Inner Suburbs					
Roslindale	1	16	28	25	29
South Dorchester	2	22	44	18	14
Hyde Park	1	18	21	32	28
West Roxbury	2	10	25	27	36
Subtotal	2	18	34	23	23
Total	2	19	38	23	18

Source: MDES mid 1975 Special Survey

(FIG. II-19)

DISTRIBUTION OF UNFILLED JOB OPENINGS

By Major Occupational Categories
Boston and Metro Job Banks
June 1974-June 1975

	June '74	Percent	Sept.'74	Percent	Dec.'74	Percent	March '75	Percent	June '75	Percent
ALL OPENINGS	4,998	100.0	5,333	100.0	1,973	100.0	2,432	100.00	2,287	100.0
Professional, Technical and Managerial	1,167	23.3	1,286	24.1	594	30.1	597	24.5	609	26.6
Clerical & Saleswork	1,381	27.6	1,533	28.7	479	24.3	748	30.7	691	30.2
Services	570	11.4	952	17.9	232	11.8	216	8.9	304	13.3
Farming, Forestry and Fisheries	6	0.1	16	0.3	20	1.0	9	0.4	25	1.1
Processing	73	1.5	54	1.0	64	3.2	16	0.7	15	0.7
Machine Trades	589	11.8	287	5.4	137	6.9	255	10.5	132	5.8
Bench Work	484	9.7	316	5.9	91	4.6	265	10.9	210	9.2
Structural Work	494	9.9	414	7.8	250	12.7	209	8.6	183	8.0
Miscellaneous Work	234	4.7	475	8.9	108	5.5	117	4.8	118	5.2

Source: Massachusetts Division of Employment Security

2.3 The Natural Environment

2.3.1 Air Quality

Among other factors, the air quality of a region is directly related to the quantity of various pollutants emitted into the local atmosphere. In the project area, the greatest contaminant emissions are from transportation sources - automobiles, buses, and trains. The principal pollutant emitted by these mobile sources are carbon monoxide, unburned or partially burned hydrocarbons, oxides of nitrogen, and particulate matter. Gasoline-powered motor vehicles contribute the greatest quantity of these pollutant emissions. In addition to transportation sources, other activities in the project area affecting air quality are steam-electrical power generation facilities, fuel combustion in boilers for space heating and process heat, and solid-waste incineration. These stationary sources emit principally sulfur dioxide and particulate matter.

Sources and Effects

Carbon monoxide (CO) is the most prevalent of all air pollutants in urban areas. CO emissions result from the incomplete combustion of fossil fuels. It is a highly stable gaseous contaminant related predominantly to automobile exhaust. Since CO is relatively inert and generally emitted at ground level, the concentrations tend to maximize close to the source (a freeway, for example), and the pollution problem is usually localized.

The principal toxic action of CO is a result of its combination with blood hemoglobin (Hb) to form carboxy-hemoglobin. This compound interferes with the life-sustaining transfer of oxygen from the lungs to the body tissues and the return of carbon dioxide from the tissues to the lungs. The presence of relatively small amounts of CO result in significant interference with essential cardiovascular-respiratory functions. Relatively brief exposure to high levels (40ppm) can impair time interval discrimination, visual acuity, and other psychomotor functions. An exposure time and level associated with normal commuter freeway driving is adequate to produce these effects.[1] Longer exposure and higher levels may cause headaches, drowsiness, and eventually respiratory failure and death.

Hydrocarbons are a family of organic compounds consisting solely of hydrogen and carbon. The largest component of world-wide hydrocarbon emissions is non-reactive methane from natural biological sources and is of lesser concern than reactive compounds. The chief sources of the reactive species are man-made and arise from the incomplete combustion of gasoline by motor vehicles, industrial process evaporative losses, and other fuel use activities. There are no known <u>direct</u> health effects from exposure to hydrocarbons at levels found in the atmosphere. The major known pollutant effects of reactive hydrocarbons result from their interaction with nitrogen oxides in the atmosphere to form photochemical oxidants.

Photochemical oxidants (O_3) are not directly emitted by any man-made source in significant quantities. Rather, they are a class of atmospheric pollutants which arise from a complex series of photochemical reactions between hydrocarbons and oxides of nitrogen in the presence of sunlight. The observed effects of photochemical oxidants include eye and respiratory irritation, increased aging of red blood cells, impaired delivery of oxygen to the body tissue and shortness of breath. Associated problems include damage to vegetation, the fading of textiles, dyes, and paint and the cracking of rubber.

Nitrogen oxides arise mainly from high-temperature combustion processes which are followed by rapid cooling. Motor vehicle emissions and the burning of coal, oil, and natural gas are the principal sources. In addition to contributing to the formation of photochemical oxidants, nitrogen oxides have

[1]"Instrumentation for Environmental Monitoring": Air, Environmental Instrumentation Group, Lawrence Berkeley Laboratory, University of California, Berkeley, California, December, 1973.

several direct damaging effects. Nitrogen dioxide (NO_2) exerts its primary toxic action on the lungs. High concentrations are lethal to most animal species, causing pulmonary edema. Epidemiological studies have correlated NO_2 concentrations with increases in respiratory diseases in people. Chronic plant injury is associated with exposure to NO_2. Associated problems include decreased visibility, textile fading and deterioration, and corrosion of electrical wiring.

Sulfur dioxide (SO_2) arises mainly from the combustion of coal and petroleum by stationary sources. SO_2 in the presence of fine particulates and water vapor can form sulfuric acid deep in the lungs. Studies have linked SO_2 with the incidence of acute respiratory diseases and their associated mortality rates. In addition, laboratory experiments have found sulfur dioxides to be damaging to animals, plants, building materials, art works, textiles, and paints. SO_2 is also thought to be the cause of acid rain in many areas.

The current controversy over the use of catalytic mufflers on new model cars concerns the possibility that they may cause the formation of sulfuric acid mist in the automobile exhaust from the small amounts of sulfur present in gasoline. Based on the most recent EPA test results from August 1975[1], it now appears that both noncatalyst cars and catalyst equipped cars without air pumps emit very low levels of sulfuric acid at all speeds. By contrast, catalyst cars equipped with air pumps emit high levels of sulfuric acid at highway speeds. It is this potential for high emissions that led the EPA Administrator to suspend the 1977 hydrocarbon and carbon monoxide standards. Without the suspension, manufacturers might have added air pumps to 1977 model cars to meet the stricter standards. In addition, EPA is expected to promulgate emission standards for sulfuric acid in early 1976 to insure that the implementation of stricter emission standards for carbon monixide, hydrocarbons, and nitrogen oxides will not cause a concurrent health hazard from sulfuric acid emissions.

It is now generally agreed that particle size is a major factor in determining the toxic effects of airborne particulate matter. In general, pulmonary deposition increases as particle diameters decrease, with particulate matter less than 1 μm* in diameter of primary importance. Recent studies have shown a number of potentially toxic trace species, including lead, cadmium, antimony, selenium, nickel, vanadium, zinc, cobalt, bromine, manganese, sulfate, and benzo[a]pyrene, predominate in small, lung-depositing particles in most urban aerosols.

In urban areas, the bulk of total suspended particulate matter (TSP) in the air is due to fuel burning, industrial processes, and road dust. Chronic exposure to high concentrations of particulate matter can be injurious to the lungs. Particulate matter is responsible for atmospheric turbidity and reduced visibility, and it is also thought to affect the earth's energy balance through changes in the earth's albedo and absorption of radiation. There is concern over ambient concentrations of lead particulates in urban environments since lead is known to be a poison. The major source of such airborne lead is the burning of gasoline containing lead additives. In general, only about 1-2 percent of the particulate matter in urban areas consist of lead particulates.[2] For an average urban adult, about 25 percent of the normal daily intake of lead will come from inhaled particulate matter; the remainder will be absorbed from food and water.[3]

[1] Environmental Reporter, Volume 6, No. 19, p. 762.

[2] Ludwig, J.H., Morgan, G.B., and McMullen, T.B., "Trends in Air Quality", presented at the national meeting of the American Geophysical Union, San Francisco, California, December, 1969.

[3] Natusch, D.F., and Wallace, J.B., "Urban Aerosol Toxicity: The Influence of Particle Size", Science, 185: p. 695-699. November, 1974.

*1 μm= 40 millionths of an inch

Air Quality Standards

National Ambient Air Quality Standards for all of the above-described pollutants (except lead) have been promulgated by the Environmental Protection Agency; these are presented in Fig. II-20. Standards for the Commonwealth of Massachusetts are identical to the federal standards. The primary standards are intended to protect the public health, while secondary standards are designed to protect the public welfare from any known or anticipated effects. The target date for attainment of national primary and secondary standards was May 31, 1975. Achievement of these standards in Metropolitan Boston, however, has been extended to mid-1977 to allow sufficient time to implement a Transportation Control Plan. To meet air quality standards, Boston must control emissions from motor vehicles to a greater extent than will be afforded by the federal new car emission controls. The Boston Transportation Control Plan is composed of a series of land use and transportation control procedures. The proposed program has four main elements:

1. An inspection and maintenance system, to ensure that the pollution control equipment on each registered automobile remains in suitable working order (effective August 1, 1976).

2. A program of parking restrictions and other incentives for reducing single-passenger commuter automobile use (effective October 15, 1973 through March 1, 1977).

3. Additional local hot spot strategies to control CO levels in areas where they are highest (effective May 31, 1977).

4. Implementation of organic solvent use regulations to reduce the emissions of reactive hydrocarbons (effective May 31, 1977).

Current Air Quality

The Commonwealth of Massachusetts Bureau of Air Quality Control (BAQC) operates air quality monitoring stations throughout the Metropolitan Boston region. The nearest operating monitoring station to the project area is located on Southampton Street in the South Bay section of Boston. Pollutants measured at this site are NO_2, SO_2, and TSP. Observational data from this site recorded during 1974 indicates that none of the federal and state primary and secondary standards for these pollutants were exceeded during the year. The annual arithmetic mean and maximum daily concentrations for SO_2 were 0.004 ppm and 0.032 ppm, respectively, far below the standards of 0.030 ppm and 0.140 ppm. The annual arithmetic mean concentration for NO_2 was 0.038 ppm, below the standard of 0.050 ppm. Finally, the annual geometric mean and maximum daily concentrations of TSP were 59 $\mu g/m^3$, respectively, each below the standards of 60 ug/m^3 and 150 $\mu g/m^3$.

Measured data on ambient concentrations of CO and O_3 in the project area are not available. However, data from other sites in the region indicate that violations of the 8-hour CO and 1-hour O_3 oxidant standards of 9 ppm and 0.08 ppm, respectively, occurred throughout Metropolitan Boston in 1974. In addition, a short-term (62 days) monitoring program conducted for the Boston Transportation Planning Review[1] along the Massachusetts Turnpike Extension and the Southeast Expressway not far from the project area in the summer of 1972 revealed repeated violations of the 8-hour CO and 1-hour O_3 standards.

[1] Willis, B.H., et.al., Air Quality Monitoring Program, prepared for the Boston Transportation Planning Review by Environmental Research and Technology, Inc., January, 1973.

(FIG. II-20)

FEDERAL AND MASSACHUSETTS AIR QUALITY STANDARDS

Contaminant	Averaging Time	Concentration Primary $\mu g/m^3$	Std. ppm	Sec. $\mu g/m^3$	Std. ppm.	Measurement Criteria[1]
Sulfur Oxides (SO_2)	Year	80	0.03	-	-	Arithmetic Mean
	Day	365	0.14	-	-	Maximum
	3 Hours	-	-	1,300	0.5	Maximum
Total Suspended Particulates (TSP)	Year	75	-	60[2]	-	Geometric Mean
	Day	260	-	150	-	Maximum
Carbon Monoxide (CO)	8 Hours	10,000	9	10,000	9	Maximum
	1 Hour	40,000	35	40,000	35	Maximum
Photochemical Oxidants (O_3)	1 Hour	160	0.08	150	0.08	Maximum
Hydrocarbons (Non-Methane)	3 Hours	160[3]	0.24	160	0.24	Maximum between 6 am and 9 am
Nitrogen Oxides (NO_2)	Year	100	0.05	100	0.05	Arithmetic Mean

[1] Standards other than those based on annual arithmetic or geometric mean are not to be exceeded more than once per year.

[2] For use as a guide in assessing implementation plans to achieve the 24-hour TSP standard.

[3] For use as a guide in devising implementation plans to achieve the oxident standard.

In conclusion, excessive levels of CO and O_3 are currently the major air pollution problems in Metropolitan Boston. For this reason the Boston Transportation Control Plan has been developed to reduce CO and hydrocarbon emissions in the region to acceptable levels within a reasonable time frame.

2.3.2. The Existing Noise Environment

2.3.2.1. Noise Scales

In order to understand the existing noise environment and how noise from the proposed project may affect this environment, it is first necessary to understand various scales that are used to measure environmental noise.

Three noise measurement scales are used in this report to describe the present noise environment and to estimate the future noise environment. These scales are necessary to address single noise events and to address various regulations and criteria. The three scales have two things in common: first, they are all measurements of the "Sound Level", and second, they are all "A-Weighted" measurements. The three scales differ in the manner in which the time varying nature of sound is taken into account. The terms, "Sound Level" and "A-Weighted" are explained briefly below, followed by an explanation of how the noise measurement scales differ.

The term "Sound Level" has a very specific meaning. It is used to refer to a logarithmic measure of small rapid pressure fluctuations in the air. A decibel (abbreviated dB) is the scale unit for twenty times the logarithm of the ratio of the fluctuating pressure amplitude to a fixed reference pressure. The logarithm of the pressure amplitude is used because human perception of sound correlates more closely to this than it does directly to the pressure amplitude. It is, however, not necessary to understand the mathematical definition of Sound Level and decibels to judge the loudness of a given sound. To help orient the reader to the magnitude of typical noises, the Sound Level of several common noise sources are shown in Fig. II-21. The following rules of thumb are useful when considering the magnitude of changes in Sound Levels:

- A change of one decible is usually only detectable under laboratory conditions.
- A change of approximately three decibels is detectable in the field. For example, if the difference in noise level between two successive trucks or trains is 3 decibels or greater, this would be noticeable.
- An increase (decrease) of ten decibels is usually considered a subjective doubling (halving) of the sound level, and such a change is significant.

The second item that all the noise scales discussed in this report have in common is that they are all A-Weighted sound levels. This takes into account the sensitivity of the human ear as it relates to the frequency or pitch of the sound. A Sound-Level meter that one can use to measure noise is just as sensitive to sounds with low pitch as it is to sounds with high pitch, but the human ear is not equally sensitive to these different pitches. Therefore, sound-level meters are equipped with electronic filters that de-emphasize both very low-pitched and very high-pitched components so that the level that is read correlates well with our human perception of loudness. Such a filter is called an A-Weighted filter.

(FIG. II-21)

TYPICAL NOISE LEVELS

Outdoor Noise Levels	NOISE LEVEL (dBA)	Indoor Noise Levels
	110	Rock Band (L_{eq})*
Jet Flyover at 1000 ft		
	100	
		Newspaper Press
Gas Lawn Mower at 3 ft		
Diesel Truck at 50 ft	90	Food Blender at 3 ft
Noisy Urban Daytime (L_{eq})	80	Garbage Disposal at 3 ft Shouting at 3 ft.
Gas Lawn Mower at 100 ft	70	Vacuum Cleaner at 10 ft Normal Speech at 3 ft
Quiet Urban Daytime (L_{eq})	60	
		Large Business Office
Quiet Urban Nighttime (L_{eq})	50	Dishwasher Next Room
Quiet Suburban Nighttime (L_{eq})		
	40	Small Theatre, Large Conference Room (Background)
Quiet Rural Nighttime (L_{eq})	30	Library
		Bedroom at Nighttime Concert Hall (Background)
	20	Broadcast and Recording Studio
	10	
		Threshold of Hearing
	0	

*L_{eq} see Fig. II-22

(FIG. II-22)

MEASURES OF ENVIRONMENTAL NOISE

Noise Measure	Description	Use
L_{max}	The maximum A-Weighted noise level occurring during an identifiable intrusive noise event.	Characterizes a single noise (truck, airplane, transit car).
L_{eq}	The equivalent sound level, or the steady noise level that would convey the same noise energy as the actual time varying noise at a site in the same time period.	Accepted by the FHWA for predicting and assessing highway noise impact.
L_{dn}	The day-night sound level: the 24 hour equivalent sound level with a 10dB penalty applied to noise levels during the 9 nighttime hours from 2200 to 0700.	Used in community noise assessments; proposed by U.S. EPA for use in environmental noise studies.

All of the noise measurement data and the predictions of this study are given in terms of the level that would be obtained by measuring the noise employing such an A-Weighted filter.

The Sound Level scales used in this report are listed in Fig. II-22. These scales were chosen to describe peak noise events and to address various regulations and criteria. The reader is referred to the section on noise impact criteria in the Appendix for a further explanation of why these scales were chosen.

2.3.2.2. Ambient Noise Measurements

The purpose of the noise measurement program was to determine present noise levels in the study area. This is necessary in order to assess possible changes in the noise environment that may result from implementation of the proposed project. Such an assessment is required by both FHWA in Policy and Procedure Memorandum (PPM) 90-2 and UMTA in their Order 5610.1.

The sites where noise measurements were made for this project are shown in Fig. II-23. In general most of the sites can be classified as sites that are particularly sensitive to noise. Included are Boston City Hospital, playgrounds and housing that could be affected by relocation of rapid transit operations from Washington Street to the Penn Central alignment, and the construction of a new arterial road. At each of these sites the noise was measured for 24 hours with an instrument that samples the sound level eight times every second. This type of measurement gives a full statistical description of the variation of the sound for each hour of the day and for the day as a whole.

A summary of the noise measurement results is presented in Fig. II-24, and the results of the noise measurements at the Northeastern University/Carter Playground site are shown in Fig. II-25. Similar results for the other sites are included in the Appendix. The following discussion describes the present noise environment in the Southwest Corridor Study Area.

In general, environmental noise levels in the study area are high. The day-night sound level (L_{dn}) at the 12 measurement sites range from a low of 64dB at Madison Park to a high of 80dB at Boston City Hospital, at 31 Cumberland Street, and at 20 St. Charles Street. The L_{dn} at most sites is in the mid 70's, situations which would be classified by the U.S. Environmental Protection Agency as very noisy residential areas. In general the major noise sources in the study area are traffic on arterial streets, the present elevated MBTA Orange Line on Washington Street, trains along the present Penn Central alignment, and for one short segment the Massachusetts Turnpike.

One of the major objectives of this Impact Analysis is to study the elimination of the present elevated MBTA rapid transit line along Washington Street. Noise levels near this structure during the passage of a train are extremely high. Peak passby sound levels at measurement Site No. 7 (6 Chilcot Place) were in the mid to high ninety decibel range. This site was approximately 100 feet from the elevated structure. Noise levels at some of the nearer buildings and directly under the elevated structure are approximately 100 to 110dBA. These levels are loud enough to cause speech interference inside the closest residences even with the windows fully closed.

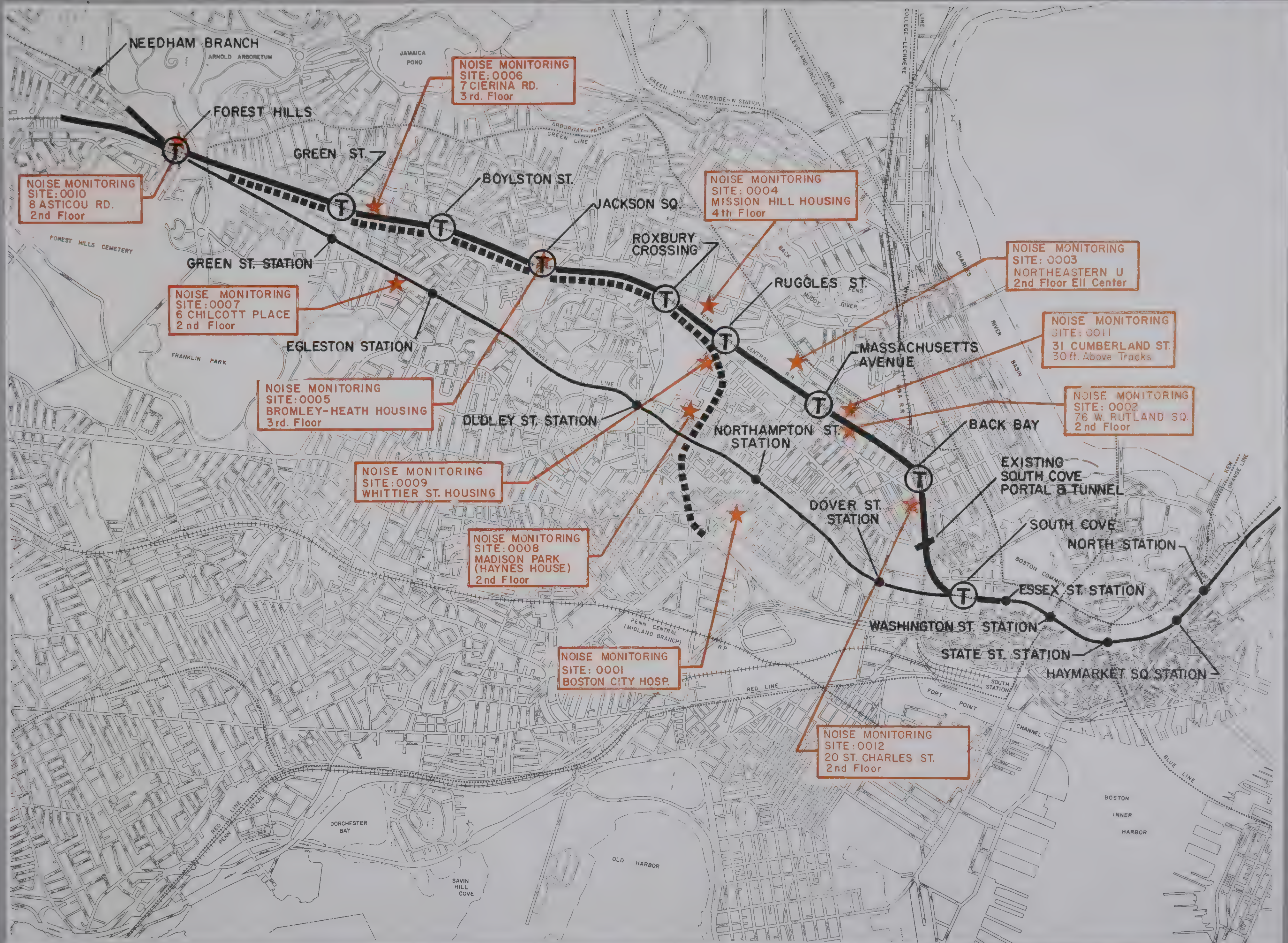
Several noise measurements were taken along the Penn Central alignment because it is the alignment proposed for the relocation of the MBTA Orange Line. Between Forest Hills and Massachusetts Avenue, the facility is on an embankment. Generally this area is bordered by houses that are 200 feet or further from the track, industrial buildings, two major housing projects adjacent and a portion of Northeastern University.

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

SITE MAP
NOISE MONITORING



LEGEND

★ NOISE MONITORING SITE

SCALE
0 1200 2400 3600
NORTH

FIGURE
II-23

(FIG. II-24)

SUMMARY OF MEASURED A-WEIGHTED SOUND LEVELS

DAYTIME/NIGHTTIME LEVEL*

POSITION	L_{dn}	L_{max}	L_{eq}	MAJOR NOISE SOURCE
1. Boston City Hospital	80	106/101	77/71	Mass. Ave. Traffic, Construction
2. 76 W. Rutland Square	70	96/90	70/61	Trains, Columbus Avenue Traffic
3. Northeastern Univ. (Carter Playgrnd)	73	96/96	69/66	Trains
4. Mission Hill Housing	74	99/99	72/67	Trains, Columbus Avenue Traffic
5. Bromley-Heath Housing	76	105/98	74/68	Trains, Local Traffic
6. 7 Cerina Road (near Green St. Playground)	70	95/94	68/62	Trains
7. 6 Chilcot Place	78	98/95	77/69	MBTA Orange Line, Wash. St. Traffic
8. Madison Park (Haynes House)	64	95/98	63/54	Shawmut Avenue Traffic
9. Whittier St. Housing	76	103/100	74/68	Tremont St. and Columbus Avenue Traffic
10. Asticou Road	68	100/91	66/60	Trains, Washington Street Traffic
11. 31 Cumberland Street	80	110+/110+**	78/73	Trains
12. 20 St. Charles Street	80	104/98	77/72	Mass. Turnpike Traffic, Trains

* Daytime = 7AM to 10PM, Nighttime = 10PM to 7AM.

**Peak Noise levels at this site overloaded the recording instrument at 110dBA.

Noise levels from the diesel engine trains (and two gas turbine trains) that use this right-of-way are approximately as high as for the elevated Orange Line on Washington Street, however, volumes are not nearly as high and people do not live as close to the tracks. The worst noise condition along this section of the alignment is probably at the Bromley-Heath Housing project. One building here is approximately 100 feet from the alignment, and peak noise levels reach 100dBA during the passage of a train. It should be kept in mind that one reason peak noise levels are so high near this alignment is that most diesel-electric locomotives are not muffled.

Further north, between Massachusetts Avenue and Back Bay Station, the same trains pass. The major difference here is that row houses directly abut the rail alignment on the north side of the tracks. Two measurements were performed in this area. On the north side of the tracks a measurement was made at 31 Cumberland Street at a window that faces the tracks. Peak noise levels here exceed 119dB and the L_{dn} was 80dB, a level that exceeds by approximately 10dB what EPA would classify as a very noisy urban residential site. On the south side of the tracks a measurement was made at 76 West Rutland Square. This site, on a street that is perpendicular to the rail alignment, was approximately 150 feet from the nearest track. Peak levels during the passage of a train are in the mid 90's and the L_{dn} was 70dB. Vibration is also a problem here; the passage of passenger trains at 30 mph is clearly perceptible in the nearest houses.

The measurement site at 20 St. Charles Street overlooks not only the Penn Central alignment but also the Massachusetts Turnpike. Peak noise levels here were not quite as high as a few other locations, but the L_{dn} was 80dB and the FHWA design noise level of L_{eq} 67dB was exceeded by more than five decibels for every hour of the day. The measurements indicate that the Turnpike contributes more to average noise levels than trains.

The Whittier Street, Madison Park and Boston City Hospital measurements were performed because these sites may be affected by noise from the new arterial street rather than train or rapid transit noise. The noise environment at Whittier Street is controlled by traffic on Tremont Street, Columbus Avenue and Ruggles Street. The noise level near Madison Park was the lowest of all the measured sites, but it would still be considered a noisy urban residential area based on its day-night sound level. The noise here is controlled by local traffic. Noise levels at Boston City Hospital are very high, peak noise levels in excess of 100dBA and an L_{dn} of 80dB were measured. The dominant noise source in this area is local traffic, especially trucks. There is a major access ramp from the Southeast Expressway just one block from the hospital, and Massachusetts Avenue is a truck route leading from this ramp.

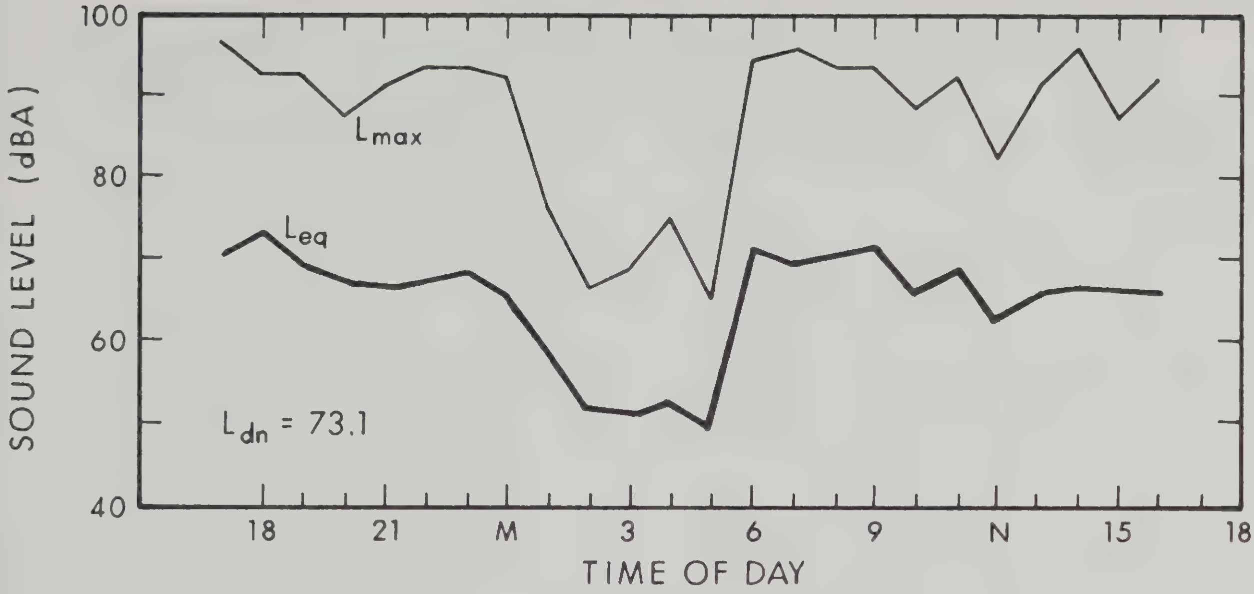
2.3.3 Geology and Soils

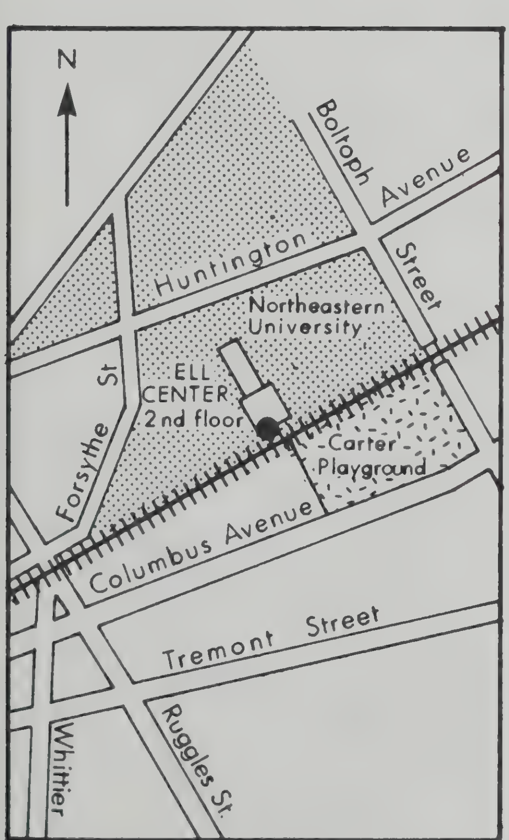
A brief description of geological sequential events and processes responsible for the surface features of the project area is as follows:

- Oldest rocks in the Boston region, Braintree Slates, (formed 500 million years ago) intruded by rocks of volcanic origin; diorite, Quincy Granite.

- Long period of weathering and erosion, rocks rotted and broken up, forming deposits of gravel, sand and clay hundreds of feet thick.

- Pressure on bottom layers of deposits so great that, combined with natural cementing agents, a rock was formed - Roxbury Puddingstone, a conglomerate of rounded boulders and sand resembling plum pudding.





Not to Scale

SITE NO: 0003

LOCATION:
Ell Center, Northeastern University (near Carter Playground)

MICROPHONE HEIGHT:
2nd Floor

MAJOR NOISE SOURCE:
Trains

OTHER NOISE SOURCES:
Columbus Ave. Traffic

TIME OF MEASUREMENT:
4PM 9/29/75 to
4PM 9/30/75

	DAY	NIGHT	24 hr.
Peak	96	96	96
L_{eq}	69	66	68

NOISE MEASUREMENTS NORTHEASTERN UNIVERSITY — CARTER PLAYGROUND

FIGURE II-25

- Layers of pure clay also deposited and hardened to shale - which with continued pressure turned to slate.

- Earths crust so weakened, in West Roxbury, that red hot lava periodically poured out from deep in the earth to form a volcano.

- Formation of conglomerates, slates and lava continued for more than a million years until so great a thickness built up to cause cracks and settlements (faults) in the earths surface triggering many earthquakes.

- Shifting of bedrock caused earth's surface to wrinkle, forming arch hills (anticlines) of conglomerates, slates and lava.

- Advance and recession of glacial ice sheets, of great depth, for more than a million years substantially altered the bedrock surface. Hills were worn down and great blocks of rock carried along and ground up to settle, when the ice melted, in haphazard mixtures of clay sand, and gravel (glacial till). This till was sometimes formed into large rounded hills called drumlins.

- As the climate moderated, great blocks of ice broke away and floated off as icebergs. Some blocks settled in sand deposits and when the ice finally melted, large depressions called kettle holes remained. Some became filled with water and are now ponds.

Conspicuous among the geological features in the area are great masses of Roxbury Puddingstone in Roxbury, West Roxbury and Dorchester; slate in Roxbury and Dorchester; volcanic rocks in Mattapan near the Neponset River; anticlines in Roxbury and the southern part of Dorchester; ledge smoothed and polished by glaciers in Franklin Park; drumlins throughout the area; a kettle hole near the Children's Museum in Jamaica Plain; Jamaica Pond and the beautiful Scarboro Pond in Franklin Park.

The Roxbury volcano became extinct some one hundred million years ago and the cone has been entirely worn away.

Soils data and subsurface conditions for the project extracted from previous reports, together with information from public agencies, indicate that the northern portion of the Penn Central Railroad is located on man-made filled reclaimed area in the Old Back Bay estuary of the Charles River. The fills consist mainly of sands and gravels, but some packets of a hetero-geneous dumping of clays, bricks and silts have been encountered. Some of the reclaimed area is underlain with organic deposits of varying depth. In many areas extensive deposits of Boston blue clay exist. Overlaying many of the blue clay deposits are 10-20 foot layers of still yellow clays that have weathered and dried out to provide relatively high bearing pressures. Bedrock throughout the northern area consists of conglomerates and may be expected to be overlain with boulders, hardpan and compacted gravels.

The southern portion of the corridor from Roxbury Crossing to Forest Hills has limited sections of man-made fills, in isolated swampy sites. The area is overlain with a thin (2 foot) layer of organic soils below which is approximately 50 feet of granular material consisting mainly of sands with intrusions of gravel and silt.

2.3.4 Water Resources

The project area lies entirely within the Stony Brook and Back Bay drainage basin. Surface runoff flows through storm drains into the culverted Stony Brook, which crosses the Corridor in three locations - at Roxbury Crossing, Forest Hills, and Ruggles Street.

Well-point data indicates that ground water will be encountered 2 to 15 feet below ground throughout most of the alignment.

Public water facilities are supplied from a central source by the Metropolitan District Commission. Within the corridor, several large water mains cross the proposed alignment of the project. Public sewage services, also supplied by the MDC, are provided throughout the area. Most of the principal water and sewage mains cross the proposed transit project at right angles.

2.3.5 Vegetation and Wildlife

The study area is predominately an urban one characterized by high-intensity residential structures and some industry. The only concentrations of vegetation and wild life are found at Forest Hills at the extreme southern end of the project. There is a children's zoo at Franklin Park as well as a public recreational and educational animal display -- a habitat exhibit of birds and animals. At the Arnold Arboretum, there is a living collection of 6,000 varieties of hardy trees and shrubs on 265 acres.

2.3.6 Archaeology

The office of the State Archaeologist is of the opinion that no appreciable archaeological impact will result from this project. (See letters which follow.)

Commonwealth of Massachusetts Office of the Secretary

Massachusetts Historical Commission

294 Washington St, Boston, Massachusetts 02108 (617) 727-8470

OFFICE OF THE STATE ARCHAEOLOGIST
BRONSON MUSEUM, 8 NO. MAIN ST.
ATTLEBORO, MA. 02703

January 6, 1976

Mr. Peter Mazza
Vice President
FREDERIC R. HARRIS, INC.
67 Long Wharf
Boston, Mass. 02110

Dear Sir :-

I have studied the map of the proposed project which involves the Penn Central embankment between Forest Hills and Mass. Ave. It appears to me that any significant archaeological site would have been destroyed in the original construction project and that there is no possibility of archaeological impact in the present project.

very truly yours
Maurice Robbins
Maurice Robbins
State Archaeologist

MR/clr

HARRIS-BOSTON

JAN 7 1976

#____________

Commonwealth of Massachusetts
Office of the Secretary

Massachusetts Historical Commission

294 Washington St, Boston, Massachusetts 02108 (617) 727-8470

OFFICE OF THE STATE ARCHAEOLOGIST
BRONSON MUSEUM, 8 NO. MAIN ST.
ATTLEBORO, MA. 02703

November 10, 1975

Mr. Peter Mazza
Vice President
FREDERIC R. HARRIS, INC.
67 Long Wharf
Boston, Mass. 02110

Dear Sir :-

I have checked the map of the proposed aterial street from Forest Hills, along the Penn. Central R.R. to Ruggles Street and compared it with the archaeological survey maps.

The type of construction to be undertaken and the previous disturbance in the area leads me to the judgement that no appreciable archaeological impact will result from this project.

Very truly yours

Maurice Robbins

Maurice Robbins
State Archaeologist

HARRIS - BOSTON
NOV 12 1975
#

3

3.0 TRANSPORTATION IN THE STUDY AREA

The characteristics of use and operation of transportation facilities in the study area have been examined and evaluated to assist in planning the proposed project. The findings of this work are presented in summary form in the following paragraphs.

3.1 The Transportation System

The study area is served by a system of rapid transit facilities, a number of MBTA and privately operated bus routes, and surface streets and highways for private travel. These facilities are shown on Fig. III-1. Also passing through the study area is a major rail facility serving Southwest commuters and intercity rail passengers.

3.1.1 Rapid Transit Facilities

Within the corridor, the elevated Orange Line provides rapid-transit service. The southern half of the line extends approximately 4.7 miles from Washington Station in downtown Boston to Forest Hills and has 7 stations, averaging 0.7 miles between stops. Trips from downtown to Forest Hills presently takes 16 minutes, achieving an average speed of 18 miles per hour. The elevated steel structure is antiquated, and noisy, and the line is considered to have a blighting effect on Washington Street, which it follows for its entire length.

Outside the Southwest Corridor, the Red Line Rapid-Transit provides service to Quincy and other portions of the South Shore, as well as to the Ashmont and Mattapan sections of the City of Boston. Even though it lies outside the Corridor, the Red Line provides a limited amount of service to the Southwest by means of buses acting as feeders as well as the light rail shuttle between Ashmont and Mattapan.

The present Light Rail service in the Corridor consists of: the Green Line Arborway service and the Ashmont-Mattapan shuttle. The Arborway Line is routed along Huntington Avenue from the subway portal south of Massachusetts Avenue to South Huntington Avenue. At Massachusetts Avenue, the Penn Central tracks are about 600 feet easterly. By following Huntington Avenue and South Huntington Avenue, the line swings widely through Jamaica Plain and its Centre Street commercial focus to terminate in the MBTA yard on Washington Street near the Forest Hills Orange Line station. Between the subway portal on Huntington Avenue and the Forest Hills terminal, it is an in-street operation subject to traffic interferences and weather conditions. It is, nevertheless, considered by many Jamaica Plain residents to be essential for access to the Fenway and Back Bay areas which are not now served by the Orange Line.

Current fares on all rapid transit lines in the study area are 25 cents, except for the Arborway Line which has an additional 25 cent surcharge for its surface operations. The light rail facility between Ashmont and Mattapan is treated as an integral part of the Red Line and may be ridden locally or with a change at Ashmont to downtown for the single fare of 25 cents.

3.1.2 Commuter Rail and AMTRAK Services

Four commuter rail routes are now operated to Back Bay and South Stations through the corridor. These routes originate in Needham, Franklin, Providence and Stoughton. The Needham branch serves eight stations between Needham Heights and Forest Hills. The Franklin branch services ten stations between Franklin and Readville (Hyde Park). The Providence service is the Penn Central main line to New York and includes service from Rhode Island and several other communities en route to Boston. The Stoughton Branch consists of only two stations. The Franklin, Providence and Stoughton services join south of Readville and travel

the Penn Central main line to Forest Hills, where they are joined by the Needham branch. Only a few of these services stop for passenger boarding or alightment at Forest Hills. Between Forest Hills and downtown all services are on the Penn Central main line tracks and embankment.

AMTRAK services are provided on the Penn Central main line tracks between Washington, New York, Providence and Boston. These services also pass through Forest Hills, en route to Back Bay or South Station in downtown Boston. All of the services pass through the Corridor and stop at Back Bay Station. Coordination with transit services at Back Bay station is, therefore, important for downtown distribution.

3.1.3 Bus System

An extensive network of surface bus routes serves the Southwest area of the Boston and adjacent communities. Fig. III-2 illustrates the routing of the MBTA buses which serve the study area. Several of the lines which serve the outer suburbs may be boarded at the Forest Hills station.

The MBTA bus network in the study area is focused heavily on the existing rapid transit line. Bus-rail transfers are particularly heavy at certain existing Orange Line stations such as Dudley, Egleston and Forest Hills. Bus routes and schedules have, therefore, been closely coordinated with rapid transit services. Because of the minimal commuter rail service at Forest Hills station, no coordination has been made between these services and bus schedules.

In general MBTA buses are operated from 6 a.m. until 1 a.m. at night. Midday frequencies range from 12 to 30 minutes on MBTA routes, with more frequent services on all routes in peak hours. A few routes provide only peak period service. Certain streets in the Southwest Corridor are notable for the frequency of bus service each is provided. These include Washington Street in Roslindale, and Warren Avenue approaching Dudley Square. Both of these routes have services closely linked to rapid transit access points.

As of January 1976, the basic MBTA bus fare is 25 cent, with no transfer privileges. Transfer between buses and rapid transit means a full additional fare.

3.1.4 Streets and Highways

Within the study area there is a very limited system of arterial streets. The only street that traverses the entire Corridor continuously from the CBD to Forest Hills is Washington Street. However, this street has limited capacity as an arterial street because of the restricted width, the overhead transit structure, and parking interferences caused by the commercial development throughout much of its length.

The two most important north-south arterial streets in the Corridor (from a traffic volume standpoint) are Tremont Street and Columbus Avenue. Both of these streets lack continuity. Tremont Street begins in the CBD and extends less than one half of the distance to Forest Hills where it turns westerly and terminates in the Mission Hill section of Roxbury. Columbus Avenue also begins in the CBD and generally parallels Tremont Street to the point where the two arteries cross at Roxbury Crossing. Columbus Avenue continues to Jackson Square, about one-half mile further south, and then turns easterly to terminate at its connection with Seaver Street.

The only continuous east-west arterial street crossing the Corridor is Massachusetts Avenue. While this is a very important street, it is located near the outer fringe of the Central Business District. This location, along with the heavy residential/commercial development, makes it incapable of serving all east-west traffic needs of the entire Corridor.

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

STUDY AREA
EXISTING TRANSPORTATION SYSTEM

LEGEND

- EXISTING EXPRESSWAY
- EXISTING BUS ROUTES
- EXISTING RAIL
- EXISTING RAPID TRANSIT

NORTH

SCALE

0 1200 2400 3600

FIGURE III - 1

EXISTING TRANSPORTATION SYSTEM

FIGURE III-2

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

STUDY AREA

EXISTING BUS SYSTEM

LEGEND

- 45 EXISTING BUS ROUTES
- RED LINE STATIONS
- GREEN LINE STATIONS

SCALE

0 1200 2400 3600

FIGURE III-2

LEGEND OF EXISTING BUS ROUTES

1. Harvard — Dudley
5. Broadway Sta. — Backbay
9. City Pt. — Bway & Tremont
10. City Pt. — Dudley
11. Bay View — Kneeland
13. Savin Hill — N'hampton
15. Kane Sq. — Dudley
16. Egleston & Franklin — Andrew
17. Fields Cnr. — Andrew
19. Fields Cnr. — Dudley
21. Ashmont — Forest Hills
22. Ashmont — Dudley via Talbot
23. Ashmont — Dudley via Wash.
28. Mattapan — Arborway
29. Mattapan — Egleston
32. Cleary Sq. — Arborway
34. Dedham Line — Arborway
35. Stimson — Arborway
37. Vermont St. — Arborway
38. Wren St. — Green St. Sta.
40. Georgetowne — Arborway
41. Centre & Elliot — Dudley
42. Egleston — Dudley
43. Egleston — Stuart St
44. Seaver St. — Dudley
45. Franklin Pk. — Dudley
46. Heath & S. Hunt. — Dudley
47. Kenmore — Bos City Hosp.
48. Bos. State Hosp. — Dudley
49. N'hampton — Kneeland St.
50. Cit. Sq. — Arborway via West
55. Queensbury — Boyl. & Fairfld.
59. Chestnut Hill — Forest Hills
60. Chestnut Hill — Kenmore
65. Brighton — Kenmore
66. Allston — Dudley
68. E. Concord — Copley
692. U.Mass. — Forest Hills

EXISTING BUS SYSTEM

(FIG. III-2A)

EXISTING MBTA FEEDER BUS SERVICE, SOUTHWEST CORRIDOR

Route No.	Description	Trip Time	Approximate Frequency (Minutes) Peak Hours	Mid-day	Night	Sat.	Su.
1	Harvard-Dudley	26	6	10	20	11	11
5	Broadway Station/Back Bay	25	15/20	-	-	-	-
9	City Point-Broadway & Tremont	16	12/13	15	30	15	10
10	City Point-Dudley	24	9	10	40	15	15
11	Bay View-Kneeland	20	8	15	30	12	20
13	Savin Hill-Northampton	12	20	20	-	40	-
15	Kane Square-Dudley	17	9	10	30	10	15
16	Egleston & Franklin-Andrew	14	11	20	30	20	20
17	Fields Corner-Andrew	15	12	15	40	15	20
19	Fields Corner-Dudley	17	20	-	-	-	-
21	Ashmont-Forest Hills	18	15/25	45	-	-	-
22	Ashmont-Dudley via Talbot	20	8	9	40	12	20
23	Ashmont-Dudley via Washington	22	6	11	40	12	20
28	Mattapan-Arborway	15	20/30	-	-	-	-
29	Mattapan-Egleston	20	5	12	25	15	12
32	Cleary Square-Arborway	15	4/5	15	30	12	30
34	Dedham Line-Arborway	15	5/6	15	30	10	30
35	Stimson-Arborway	23	15	30	90	30	90
37	Vermont St.-Arborway	15	15	30	90	30	30
38	Wren St.-Green St. Station	20	15/16	23	40	23	40
40	Georgetowne-Arborway	16	40	45	-	-	-
41	Centre & Eliot-Dudley	15	9	12	30	12	30
42	Egleston-Dudley	9	9	12	20	12	20
43	Egleston-Stuart Street	22	10	17	30	16	20
44	Seaver St.-Dudley	10	9	12	20	12	11
45	Franklin Park-Dudley	14	9	12	30	10	30
46	Heath & S. Huntington-Dudley	11	30	30	30	30	30
47	Kenmore-Boston City Hospital	24	20/18	30	-	-	-
48	Boston State Hospital-Dudley	24	60	-	-	-	-
49	Northampton-Kneeland St.	12	30	30	-	30	-
50	City Square-Arborway via West	20	20/25	30	-	30	-
55	Queensbury-Boylston & Fairfield	12	25/15	30	30	30	30
59	Chestnut Hill-Forest Hills	30	40	90	-	70	-
60	Chestnut Hill-Kenmore	30	20/25	25	30	25	30
65	Brighton-Kenmore	24	20	30	-	-	-
66	Allston-Dudley	26	7	12	30	12	15
68	E.Concord-Copley	12	35	35	-	-	-
692	U.Mass-Forest Hills	27	20/30	60	-	-	-

Other important streets in the Corridor include Centre, Amory, Lamartine, Dudley, Ruggles, and Green Streets. Because of the irregular configuration of the street system in the Corridor, there are several focal points where several of the more important streets converge.

Some of the more important focal points include Forest Hills, Jackson Square, Roxbury Crossing, Dudley Square, and Egleston station. Forest Hills, Egleston station and Dudley Square are presently important transit transfer locations as well as being focal points with respect to arterial streets.

3.2 Existing Transit Usage

3.2.1 Rapid Transit Ridership

Fig. III-3 shows the ridership trends of the existing Orange Line and the Arborway Line in the Southwest Corridor. These statistics, compiled each year in the first week of December, represent boardings only, and should not be considered as average daily traffic. They are useful in ascertaining trends of ridership, however, and indicate that ridership over the past few years has been declining on the present Orange Line. Similar tabulations for the Red Line, by comparison, indicate a stable or growing ridership on both the Cambridge and South Shore portions of the line. Other lines have been declining in ridership, but not at the relatively rapid rate which has been experienced on the Orange Line.

The ridership decline on the Orange Line can only be explained in part. The line is perceived by many persons as being in poor physical condition, dirty and dangerous. Major structural repairs have been completed and painting of the structure is underway but station modernization has only begun. The fear of crime on the line or in areas through which the line passes may contribute to the declining ridership. In addition, the decline in the building of housing units over the past 20 years as well as the demolition of many housing units along with a decline in the proportion of workers within the population living in the Corridor, have adversely affected transit use.

Since there are alternative transit routes into downtown, some of the ridership may be diverted to those lines. For example, the Arborway Line (Green Line) has had substantially increased ridership in the past five years (Fig. III-3); these increases may be due in part to riders diverted from the Orange Line. Similarly, newly extended bus service from Egleston Square to downtown may be diverting traffic from the Orange Line - particularly the Lower Roxbury and South End areas. The extent of such diversions is, of course, speculative, but does assist in explaining the recent declines in Orange Line ridership. It should be noted that the drop in ridership counts between 1960 and 1961, reflects a change in counting methods at certain stations with feeder bus connections.

3.2.2 Commuter Rail Line Volumes

The Southwest Corridor, inside the City of Boston, is only partially served by commuter rail lines. Passengers boarding the the Needham, Franklin, Providence and Stoughton branches are shown in Fig. III-4. Statistics shown in this table indicates total line ridership and includes the stations within the City; namely, West Roxbury, Highland Avenue, Bellevue Avenue, Roslindale Square, Readville, Hyde Park and Mount Hope. Only a few of the trains stop at Forest Hills. Boardings are minimal because of the adjacent rapid transit station and because commuter rail fares are significantly higher than rapid transit fares.

Nearly 4,420 passengers are carried on the commuter rail lines passing through the Corridor daily, en route to either Back Bay Station or South Station. These volumes are being gradually increased by fare adjustments, improved roadbed and improved frequencies. As the commuter rail improvement program progresses, the Franklin Branch roadbed will be virtually rebuilt, and additional trains will be provided to upgrade the level of service. Improvements on other branches will follow.

3.2.3 Special Mobility

The Southwest Corridor is characterized by the large percentage of its population dependent on public transportation. However, much of the Corridor is perceived by area residents as being inadequately served by presently available public transportation, including bus, rapid transit, commuter rail,

(Fig. III-3)

ORANGE LINE SOUTH RIDERSHIP TRENDS - TWO-WAY 24 HOUR BOARDINGS[1]

Year	Total	Stations Forest Hills	Green	Egle-ston	Dudley	North-ampton	Dover	Essex
1950	144,207	22,600	4,200	15,200	62,107	9,200	7,600	23,300
1951	139,500	21,500	4,000	14,900	59,600	9,800	7,200	22,500
1952	130,500	20,300	3,900	13,500	56,600	8,700	7,100	20,400
1953	126.600	20,300	3,400	12,800	56,200	8,600	7,000	18,300
1954	121,900	20,900	3,600	12,400	53,300	7,700	5,600	18,400
1955	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1956	102,600	19,100	2,900	10,900	43,300	6,000	5,000	15,400
1957	103,200	19,400	3,100	12,200	43,300	6,200	4,800	14,200
1958	100,000	19,300	2,900	12,300	43,400	5,800	4,600	11,700
1959	103,000	19,300	2,800	10,900	41,600	5,400	11,500	11,500
1960	101,300	18,900	2,900	11,300	41,100	5,300	10,900	10,900
1961[2]	61,600	17,900	2,800	7,400	16,800	4,900	4,900	6,900
1962	58,700	16,400	2,800	6,400	14,800	4,300	4,300	9,700
1963	58,300	17,600	1,100	6,100	15,700	4,600	4,000	9,200
1964	56,800	16,800	2,200	5,600	14,000	4,600	4,400	9,200
1965	55,400	17,000	2,300	5,800	13,200	4,400	4,300	8,400
1966	55,200	17,800	2,100	5,800	12,900	4,200	4,300	8,100
1967	54,000	17,300	2,200	5,400	12,500	4,200	4,600	7,800
1968	48,300	16,100	1,900	4,900	10,600	3,700	4,200	6,900
1969	51,100	16,000	2,100	5,700	11,200	4,100	4,200	7,800
1970	45,532	15,094	1,802	5,079	10,285	3,705	3,302	6,265
1971	45,892	15,527	1,907	5,375	9,501	3,952	3,368	6,262
1972	43,898	14,104	1,790	4,961	9,031	3,876	3,710	6,426
1973	42,242	13,280	1,749	4,763	8,507	3,856	3,638	6,452
1974[3]	36,418	10,599	1,541	4,039	7,645	3,692	3,068	5,834

ARBORWAY LINE RIDERSHIP TRENDS - TWO-WAY 24 HOUR BOARDINGS[1]

Year	Total Boardings	Year	Total Boardings
1950	17,000		
1951	17,500	1963	12,100
1952	15,100	1964	12,700
1953	17,500	1965	14,300
1954	18,400	1966	15,000
1955	15,600	1967	15,000
1956	16,700	1968	15,100
1957	17,500	1969	14,400
1958	15,700	1970	13,109
1959	16,300	1971	13,254
1960	16,300	1972	14,243
1961[2]	11,100	1973	12,640
1962	11,300	1974[3]	14,649

[1]SOURCE: MBTA - one day turnstyle counts, early December

[2]NOTE: Changes in method of counting in 1961

[3]NOTE: In 1974, there were about 6,000 holders of MBTA Prepaid Passes which are not included in above counts.

(FIG. III-4)

COMMUTER RAIL RIDERSHIP BY STATION (1968 - 1974)[1]

Needham Branch

Station	1968	1969	1971	1974
Needham Heights	68	77	53	75
Needham Center	156	161	118	147
Needham Junction	274	313	248	287
Birds Hill	303	311	260	299
West Roxbury	85	167	157	166
Highland	94	107	90	106
Bellevue	122	130	123	105
Roslindale	231	240	201	182
TOTAL - Needham Branch	1,433	1,506	1,250	1,367

Franklin Branch

Station	1968	1969[2]	1971[2]	1974
Franklin	166	137	N/A	119
Norfolk	33	28	33	43
Walpole	77	66	42	62
Plimptonville	11	8	4	6
Windsor Gardens	N/A	N/A	78	83
Norwood Central	305	319	203	282
Norwood	93	82	103	134
Islington	61	64	69	87
Rustcraft	4	0	0	1
Endicott	203	210	185	198
TOTAL - Franklin Branch	953	914	717	1,015

Providence (Main Line)

Station	1968	1969[2]	1971[2]	1974
Providence	184	N/A	N/A	102
Pawtucket	33	N/A	N/A	37
Attleboro	203	N/A	N/A	202
Mansfield	272	N/A	N/A	346
East Foxboro	11	N/A	N/A	70
Sharon	350	210	285	364
Canton Junction	407	394	370	427
Route 128	741	643	500	379
Readville	62	79	59	94
Hyde Park	148	165	144	89
Mount Hope	20	13	16	9
TOTAL - Main Line	2,431	1,504	1,374	1,787

Stoughton Branch

Station	1968	1969	1971	1974
Stoughton	215	303	N/A	220
Canton	42	37	22	29
TOTAL - Stoughton Branch	257	340	22	249

Summary

	1968	1969	1971	1974
Needham Branch	1,433	1,506	1,250	1,367
Franklin Branch	953	914	717	1,015
Providence (Main Line)	2,431	1,504	1,374	1,787
Stoughton Branch	257	340	22	249
TOTAL COMMUTER RIDERSH.	5,074	4,264	3,363	4,418

[1]SOURCE: Penn Central Conductor's Audits

[2]NOTE: Does not include persons boarding commuter rail who reside outside MBTA district.

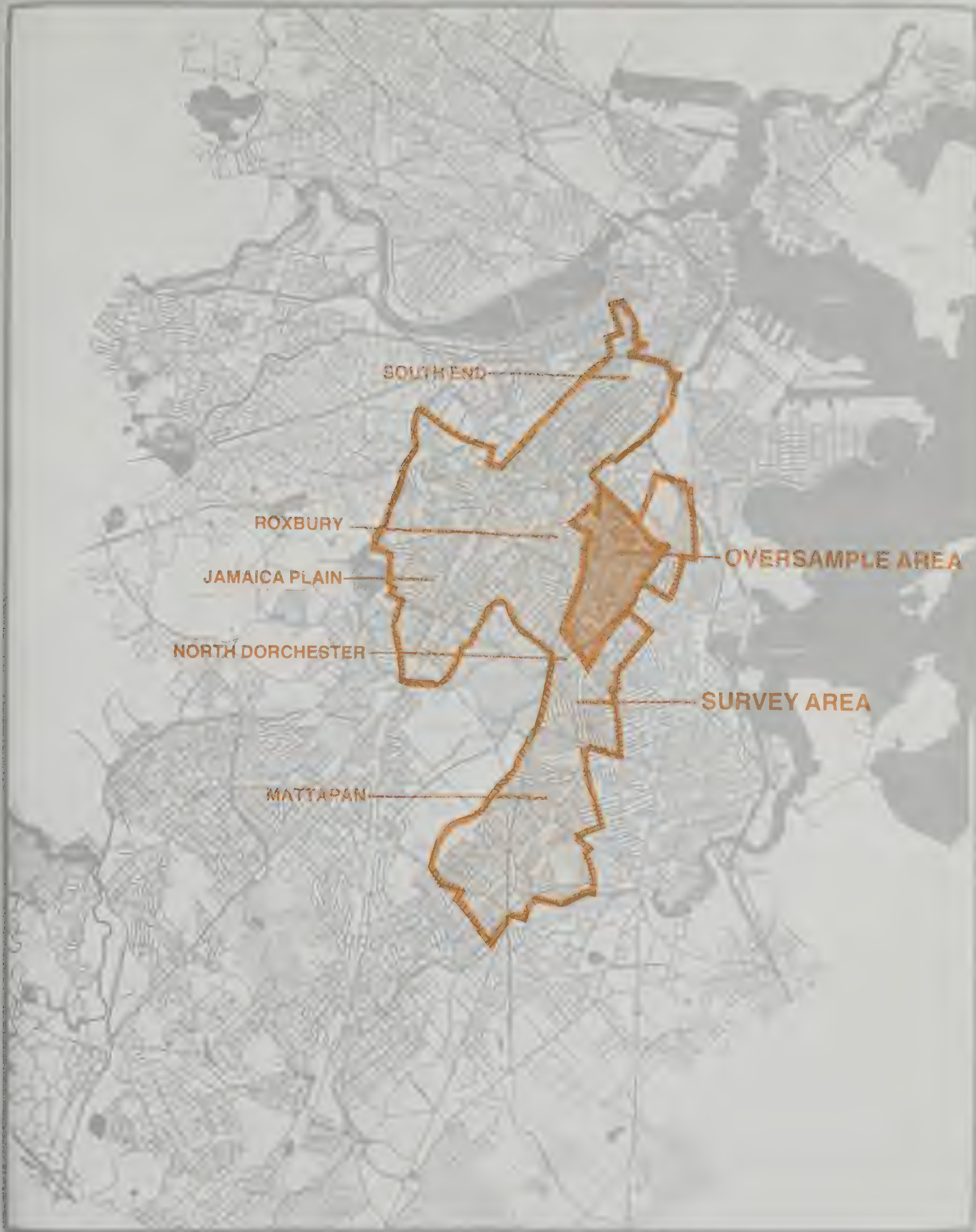
chartered vehicles, or taxicabs. This problem stems from several sources: incomplete geographic coverage by MBTA bus routes in a few areas; insufficient frequency of bus service; unavailability of taxis in major segments of the Corridor; lack of local resources to charter vehicles on a regular basis; and excessive transferring or walking, particularly for crosstown movements. The importance of this description is to underscore the continued transit dependence of residents of the Southwest Corridor.

The problems are accentuated for transit dependent individuals because all or most of their travel must be made on public transportation vehicles. Off-peak/non-work trips are most difficult because of their dispersion timewise and geographically, but such trips may constitute the bulk of travel demand by the transit-dependent population. Coupled with the difficulty of delivering needed services in the Southwest Corridor -- particularly the inner city portion -- are the unique problems brought about by the large proportion of the population which is especially disadvantaged. These people include the poor, the elderly, the handicapped and the young. The transportation needs of these residents, as determined by BTPR, are substantial in the Southwest Corridor. The groups requiring special mobility services include:

> The elderly. . . (100,000 are age 65 and over in the Southwest Corridor) who have physical difficulties using public transit. Their mobility is limited by poor transit service for shopping, health care or social services, and social-recreation trips.
>
> The young. . . (114,000 are between age 10 and 17 in the Southwest Corridor) who are dependent on transit to reach school and recreation areas.
>
> The handicapped. . . (47,000 are disabled in the Southwest Corridor) are often unable to use the present transit to reach school and recreation areas.
>
> The poor. . . encompassing a large proportion of the above groups but also including substantial numbers of working people whose transit-dependence limits their mobility for work, shopping, and all other trips. Twenty-three percent, or 44,000 families, in the Southwest had incomes under $6,000, making car ownership an economic burden.

In recognition of the problems of these groups in the Southwest, a "Special Mobility Study" was carried out to determine the need for new systems of transportation to meet previously unmet or latent needs. A home interview survey was conducted in the Southwest inner city areas of the City of Boston. The home interview survey consisted of a one percent sample of a study area which included parts of the South End, Roxbury, North Dorchester, Jamaica Plain, and Mattapan and a 3.5 percent sample of an area in Roxbury and North Dorchester (see Fig. III-5). The area sampled was chosen by community groups because it contained a large number of female headed households and Spanish-speaking persons as well as appearing to be especially deficient in transit services. The survey was designed to elicit information about present trip making patterns and latent transportation demand for work, day care, medical, education, recreation and shopping trips. Attitudes towards usage of different modes of transport were also sought.

Work trips -- The survey area had about 1.1 workers per household or approximately 80,000 total. There were three workers for every two households with incomes over $6,000 and two workers for every three households with incomes under $6,000. Since there were few two-car families in the area, these figures imply that workers in households with higher incomes have problems reaching work similar to poor families with no cars. Fig. III-6 shows the mode of access to work. Workers from poor families depend more on transit than those from non-poor families; nearly half of all workers use transit. Nearly one quarter of workers in poor families used the Orange Line to reach work.



SOUTHWEST SPECIAL MOBILITY STUDY AREA

FIGURE III-5

(FIG. III-6)

SURVEY AREA MODAL USE BY PURPOSE AND INCOME

	Poor	Incomes $6,000	Elderly	Total Population
Percent Work Trips				
Taxi	neg.	neg.	---	0.7
Auto	26	46	---	40.0
Walk	11	12	---	11.0
Orange Line	24	14	---	17.0
All Transit	63	41	---	48.0
Percent Grocery Shopping Trips (to)				
Taxi	6	3	2	5.0
Auto	32	60	45	47.0
Walk	42	26	41	32.0
Transit	20	11	12	17.0
Percent Grocery Shopping Trips (from)				
Taxi	26	15	13	21.0
Auto	31	60	45	48.0
Walk	31	18	34	23.0
Transit	11	7	8	8.0
Percent Medical Trips				
Taxi	19	11	16	14.0
Auto	23	46	29	13.0
Walk	16	12	17	13.0
Transit	26	16	21	21.0
Transit*	26	16	21	21.0

Source: BTPR
*More than 1 transfer

Major work destinations for all workers were: downtown Boston (31 percent); Roxbury and North Dorchester (21 percent); the Fenway (6.5 percent); and Cambridge (6.5 percent). Fig. III-7 shows the distribution of work destinations. Survey data indicated the difficulty of making circumferential trips and the necessity of multiple transfers for trips to the Fenway, Back Bay and Cambridge areas.

Reverse commuting is clearly a problem solved most easily by households with an automobile. Of the 16 percent work trips which were along or beyond Route 128 or in the North Shore, 80 percent were by automobile.

Shopping, Medical and Recreation Trips -- A majority of low-income households and elderly shoppers either walk to stores or take transit. On the return trip, many shoppers use taxis because of the difficulty of managing packages on transit or while walking.

Sixteen percent of medical trips were to City Hospital. The majority of the remaining trips were to medical facilities in the Fenway area requiring difficult crosstown travel for about 35 percent of the families.

Recreation trips showed a substantial dependence on the private automobile. Two-thirds of the households surveyed used a car to reach parks or beaches as compared to one-fourth who used public transit. Nearly half of the households without cars relied on others with a car to drive them to recreation areas.

Latent Demand -- The survey provided a limited insight into latent demand not only through the obvious dependence of Survey Area residents on fixed route transit, but also through responses to questions about desired trip destinations that were inaccessible. Twelve percent of the households surveyed indicated there was a potential work place that they could not reach. Twenty-eight percent of the shoppers indicated a desire to shop in areas inaccessible by public transportation. Ten percent of the respondents had similar answers with respect to medical trips for their children. Seventeen percent of the families said they would like to go to a park or beach which is inaccessible by public transportation.

3.2.4 Problems of Public Transportation Service

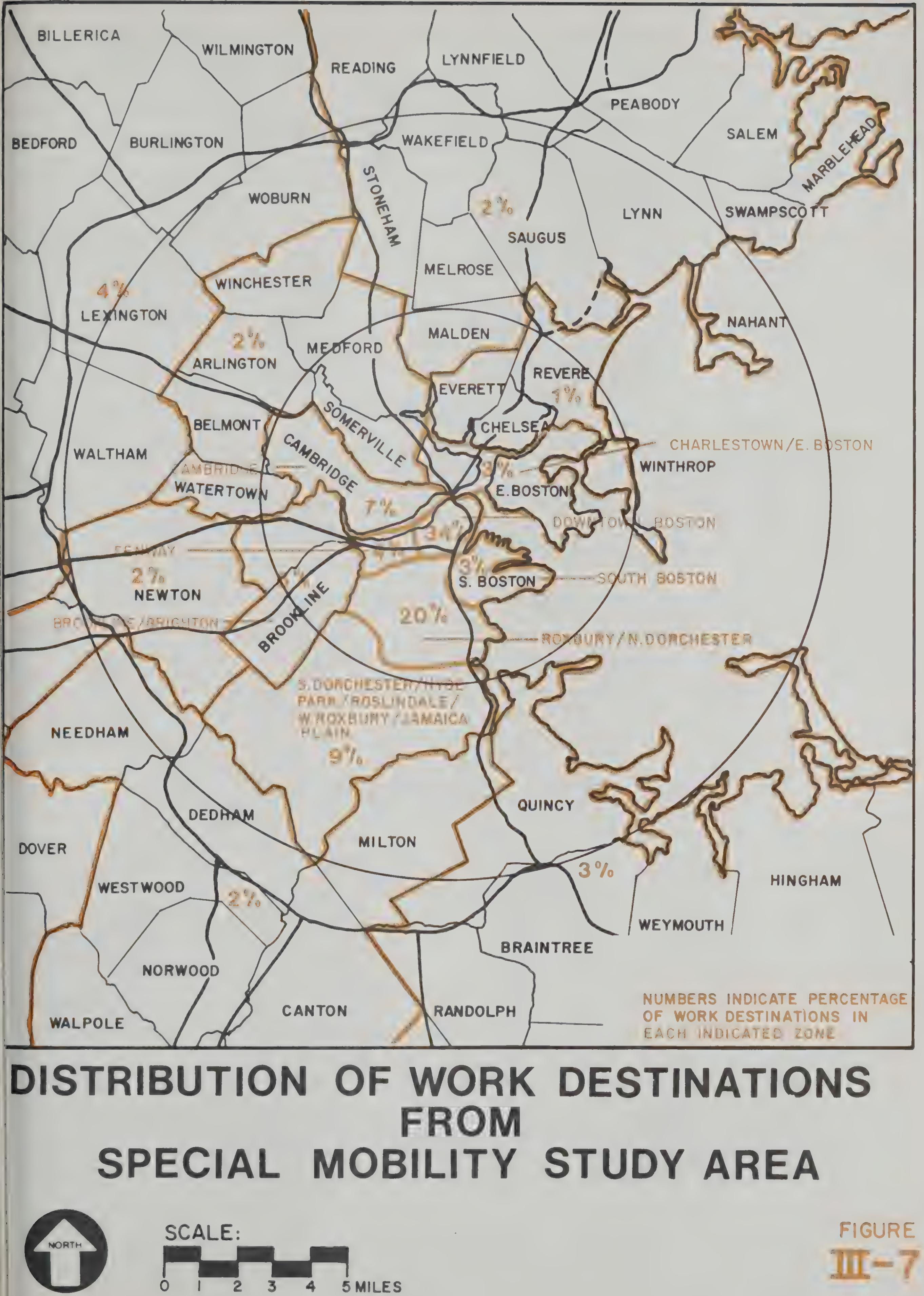
Studies of transit user attitudes provides what may be a typical ranking of transit service problems:

- Reliability
- Frequency
- Speed
- Crowding
- The "sensory" or comfort attributes- sight, sound, smell, feel
- Availability of information

Also not ranked, but clearly an important problem area, is that of transit service coverage and linkage - the extent of nearby service availability, the destinations served, and the reasonableness of fares.

Attitudes of the non-user of public transportation must also be taken into consideration. The relationship of transit service to the neighborhoods through which it passes in terms of noise, pollution and support of commercial activity and development are also important.

Reliability -- Problems arising from breakdowns and irregularity of service are frequent at the present time. Bus services are seriously affected by traffic congestion as well as the previously named factors. From observation of conditions in the Southwest, it would appear that the most serious traffic problems arise from parking violations rather than excessive moving vehicle volumes. Double and even triple parking is prevalent.



DISTRIBUTION OF WORK DESTINATIONS FROM SPECIAL MOBILITY STUDY AREA

FIGURE III-7

Frequency -- Examples of existing service frequencies in the Southwest are listed in Fig. III-8.

(FIG. III-8)

EXISTING TRANSIT SERVICE FREQUENCY IN SOUTHWEST

	HEADWAY (1) (Trains/buses)		
	Peak	Mid-day	Evening
Orange Line	4	6	15
Arborway Green Line (3 minute headway at peak hour to Northeastern)	6.5	5	12
Mattapan-Egleston Bus Route	5	12	30
Ashmont-Dudley via Talbot Avenue Bus Route	5	10	40
Mattapan-Arborway Bus Route	15	30	None

(1) Minutes between successive vehicles

The table above indicates that peak-period frequencies are generally adequate to provide a good level of service. During the mid-day period, frequencies appear to be reasonable although waiting times, particularly if regularity of service is not maintained will begin to deter transit riding. The indicated half-hourly evening service on bus routes given as typical examples cannot be considered favorable to transit utilization, although it must be assumed that demand for more frequent service is not now clear.

Speed -- Travel by private automobile must be the standard against which transit services are judged with respect to speed. Because of the walking and waiting associated with travel by transit, overall trip time can only rarely be the equal of that attainable by automobile, but grade-separated transit can often produce better running times than automobiles in congested traffic. Fig. III-9 lists estimated transit door-to-door travel and existing auto travel times to the Boston Core.

(FIG. III-9)

TYPICAL DOOR-TO-DOOR TRAVEL TIMES TO DOWNTOWN
(Intersection of Washington and Summer Streets)

Location	Auto Distance (miles)	Auto Time (minutes)	Transit Time (minutes)
Dudley Square	3.4	14	21
Roxbury Crossing	4.0	16	27
Grove Hall	4.4	18	33
Forest Hills	5.9	22	27
Roslindale	8.1	26	32
West Roxbury	9.1	29	35
Readville	10.4	38	36
Needham	14.8	42	55

SOURCE: CTPS Highway and Transit Networks

By restricting the examples of transit speed to CBD-destined trips only the most favorable examples for transit are shown. All the higher-speed transit facilities are radial, and the slowest average automobile speeds generally are those on radial routes to downtown Boston. Thus, an examination of non-radial

or circumferential trips within the Corridor would show that there is a uniform, wide-spread need for improvement if transit is to be made competitive with the automobile for non-core oriented travel.

Crowding -- At the present time, peak-hour overcrowding is a fault of the transit services. Aside from its direct unfavorable impact on riders, overcrowding has a serious secondary disadvantage in that unloading and loading are much slower than if a reasonable ratio of passengers per car is maintained. Stopped time delays not only increase running time, but also contribute to the irregularity of service.

Comfort -- Crowding is one facet of passenger discomfort. In addition, the appearance and cleanliness of transit equipment and stations is important. Noise levels also are a problem.

Availability of Information -- The MBTA has begun a service of more effective public information and marketing.

Transit Coverage and Linkage -- While most of the Corridor has some transit service within five minutes walk - at least at peak hours - the usefulness of a transit route is closely related to the potential destinations it services directly, since trips requiring transfers are generally somewhat circuitous, always more time-consuming, and usually more costly. It is not practicable to link all points in a transit network directly to all other points with no more than one convenient transfer to other significant destinations. In the Southwest, large portions of the area require double transfers to reach the Back Bay employment center and the Fenway hospital and educational institutions. The commuter rail territory also has limited downtown distribution.

3.3 Existing Traffic Characteristics

The arterial street system in the Southwest Corridor is illustrated in Fig. III-10. In addition, the signalized intersections are shown as well as an indication of the relative volumes on the arterial streets. This network of streets serves a major sector of the city with a consequent high demand for both radial and circumferential traffic movements. The lack of street continuity, the poor street alignment, the restricted width of the traveled way, the numerous marginal frictions caused by parking, loading and/or unloading, driveway access points, and intersection conflicts all contribute to a street system with an insufficient capacity to effectively serve the present demand.

3.3.1 Average Annual Daily Traffic

Average daily traffic volumes (1975) are shown in Fig. III-11 for the major streets in the study area. The section of Columbus Avenue between Roxbury Crossing and Jackson Square carries the highest volume of any street in the Corridor with approximately 36,400 vehicles daily. Other high volume streets and roadways include the Arborway (38,000), Jamaicaway (34,000), Columbus Avenue between Jackson Square and Washington Street (24,500), Massachusetts Avenue (24,500 to 27,000), Columbus Avenue north of Ruggles Street (16,500 to 18,400), and Tremont Street north of Ruggles Street (15,000 to 17,000).

Because of the lack of continuity of most of the arterial streets in the Corridor, motorists are forced to use circuitous routings to reach their destination. This type of routing adds to congestion in the area by increasing the number of turning movements at key intersections and increases the potential for accidents at these same locations. In general, however, the basic characteristic of arterial street travel in the Corridor is radial in relation to the Central Business District. Cross-town or circumferential traffic movements are of secondary importance but are very significant and poorly served by the existing street pattern. In an effort to obtain a better understanding of the travel patterns in the Jamaica Plain section of the study area, a limited origin/destination study was conducted as part of this impact analysis study.

3.3.2 Traffic Accidents

The reported traffic accident records for the years of 1972, 1973 and 1974, (from the Registry of Motor Vehicles) were analyzed to determine the high accident locations and accident frequencies. Fig. III-12 shows the reported traffic accident locations. The accident frequency is illustrated by the size of the circles at each location. The circles indicate the yearly average number of reported accidents during the 1972-1974 period.

The three intersections with the highest yearly average number of reported accidents are Massachusetts Avenue at the Southeast Expressway Ramps, Centre Street/Jamaicaway Circle, and the Ruggles Street/Columbus Avenue intersection with 30, 28 and 26 reported accidents respectively. Other intersections with a significant number of accidents reported include the other intersections on Massachusetts Avenue, the Ruggles Street/Huntington Avenue intersection, and several other isolated intersections as shown on Fig. III-12.

3.3.3 Origin/Destination Study

A limited origin/destination study was conducted in the Jamaice Plain section operating eleven license plate recording stations on the important arterial streets shown on Fig. III-13. Observations were made during the commuting hours of 7 to 10 AM and 3 to 6 PM. A sampling of nearly 4,400 motorists was selected from among nearly 25,000 recorded license plates and mailed questionnaires. A 24 percent response was obtained from this mailing. About 80 percent of the responses were complete and useful for tabulating.

Tabulation and Analysis

A total of 779 origin/destination questionnaires were tabulated by traffic zone of trip origin and trip destination. Travel patterns for each station were obtained by multiplying the number of responses received for each station on a traffic zone basis by the ratio of the total volume of traffic passing through the station in the direction being observed to the number of responses received for that station. For example, at station number one, a total of 2,138 vehicles were counted traveling in the inbound direction during the six hours of observation. Forty six questionnaire responses were received resulting in an expansion ratio of 46.5. Therefore, each questionnaire response at station number one was equivalent to 46.5 vehicle trips.

To identify the most significant travel patterns in the Jamaica Plain area, the traffic zones were grouped to represent important sections of the metropolitan area, the city, and the study area. The 12 areas resulting from this traffic zone grouping are shown on Fig. III-14 and are identified in the following list:

Area	Section of Metropolitan Area, City or Study Area
A	CBD, Beacon Hill, South Cove, South Boston and South End
B	Dorchester and a portion of Roxbury
C	Fenway, Mission Hill and Roxbury
D	Jamaica Plain north of Morton Street and the Arborway
E	Jamaica Plain south of Morton Street and the Arborway, West Roxbury, Hyde Park, and Roslindale.
F	Brookline
G	Cambridge and Somerville
H	The entire north shore area
I	The towns generally northwest of Boston including Brighton and Allston sections of Boston
J	The towns southwest of Route 128
K	Dedham and the towns generally south of Route 128
L	Milton, Quincy, and the towns generally southeast of Route 128 including all south shore towns and Cape Cod.

The section of the proposed arterial street between Forest Hills and Jackson Square is included within area D. To illustrate the travel patterns that would have an impact on this section of Jamaica Plain most clearly, desire line diagrams for areas E, K, and L are presented in Fig. III-15, III-16, and III-17 respectively.

It is significant to note that about 45 percent of the commuter travel from area E (Fig. III-15) is directed toward the central area (area A). An additional 21 percent is directed toward area C and another 17 percent toward area D. Each of these areas lie directly in the alignment of the proposed arterial street. This strong desire (83 percent) for travel northerly from area E through area D explains the travel that occurs on such streets as Washington, Amory, and Lamartine Streets.

The travel pattern from area K is substantially different from area E as shown by comparing Fig. III-16 with Fig. III-15. The two strongest travel desires from area K are directed toward areas C (23 percent) and D (22 percent). Area A represents only 18 percent of the travel desires from area K in contrast to the 45 percent from area E. Area K also exhibits a more diverse travel desire pattern with all of the 12 areas showing a travel attraction whereas area E showed travel attractions in only 6 of the 12 areas.

The importance of Jamaica Plain as a travel corridor applies to area K as well as to area E but with less intensity. About 68 percent of the travel desires from area K lie directly in line with Jamaica Plain compared to the 83 percent from area E.

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

STUDY AREA

ARTERIAL STREET SYSTEM

ARTERIAL STREETS A.D.T. – OVER [illegible]

MINOR ARTERIAL STREETS A.D.T. – [illegible]

OTHER IMPORTANT STREETS A.D.T. – UNDER [illegible]

EXISTING TRAFFIC SIGNALS

DIRECTION OF TRAFFIC FLOW

SCALE

NORTH

0 1000 2000 3000

FIGURE III-10

ARTERIAL STREET SYSTEM

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

STUDY AREA

AVERAGE DAILY TRAFFIC

SCALE

0 1000 2000 3000

FIGURE III-11

AVERAGE DAILY TRAFFIC

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

STUDY AREA

REPORTED TRAFFIC ACCIDENTS 1972–1974

LEGEND

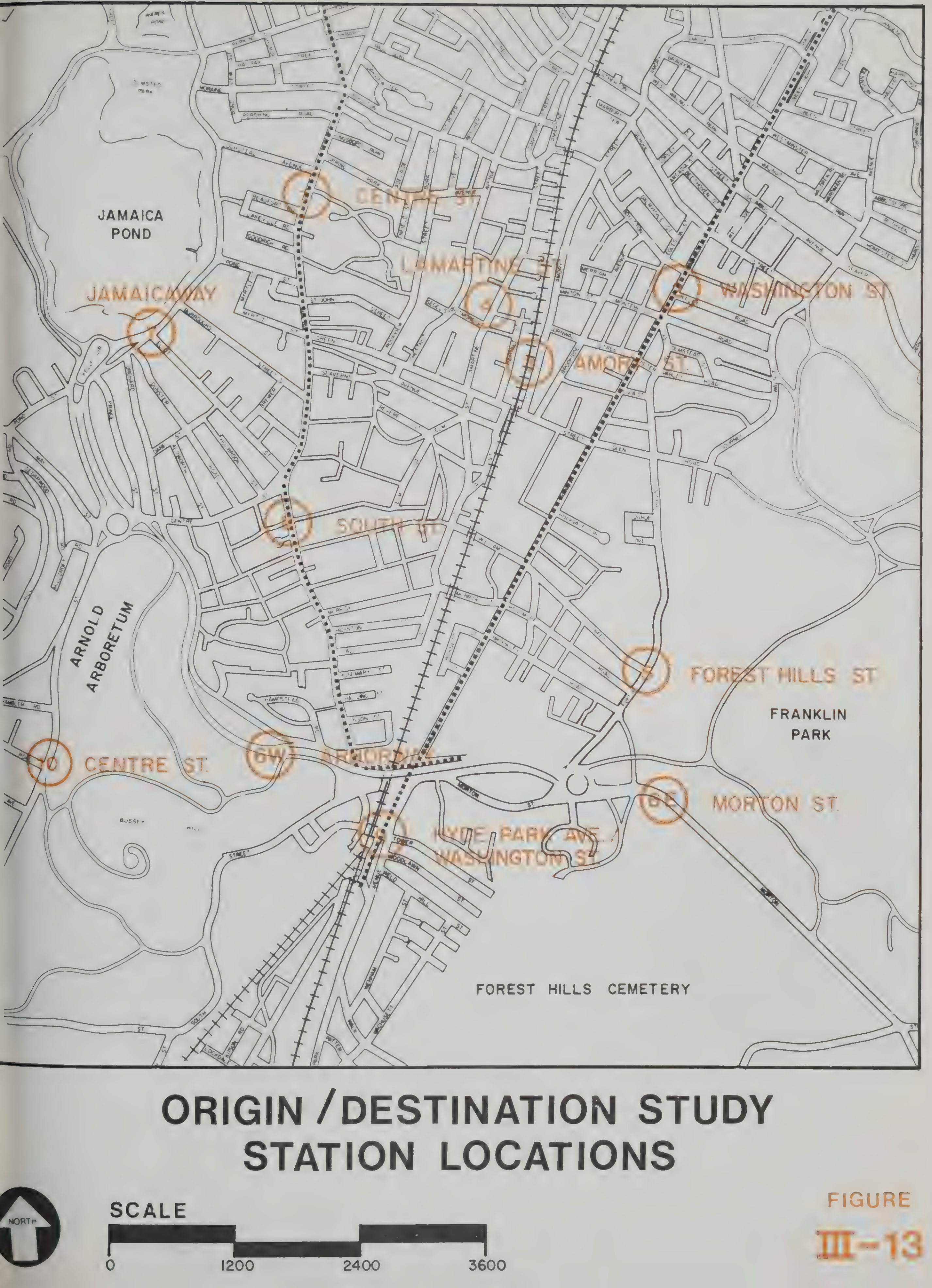
● — ONE PLUS ACCIDENTS PER YEAR

SCALE

NORTH

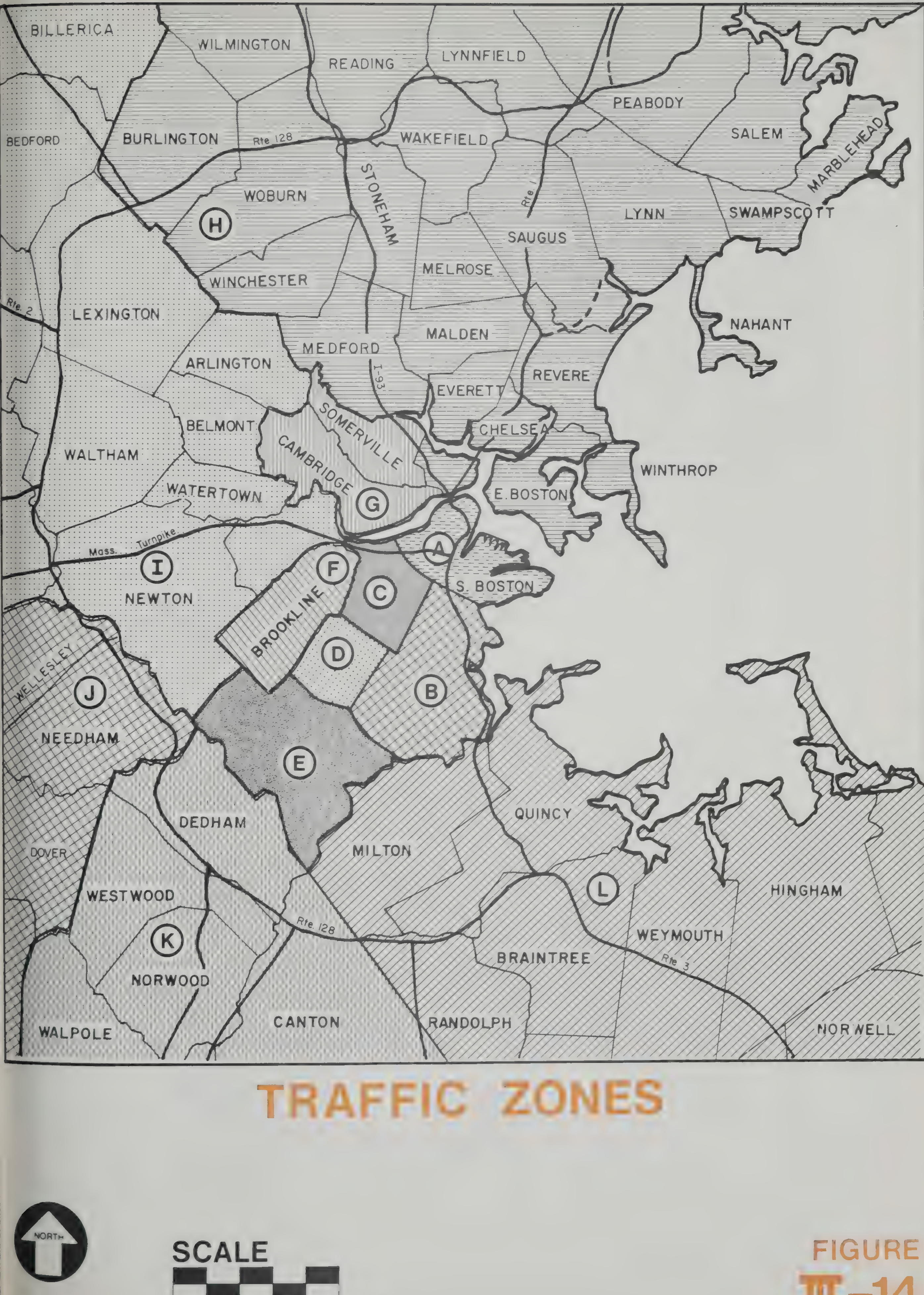
0 1000 2000 3000

FIGURE III-12



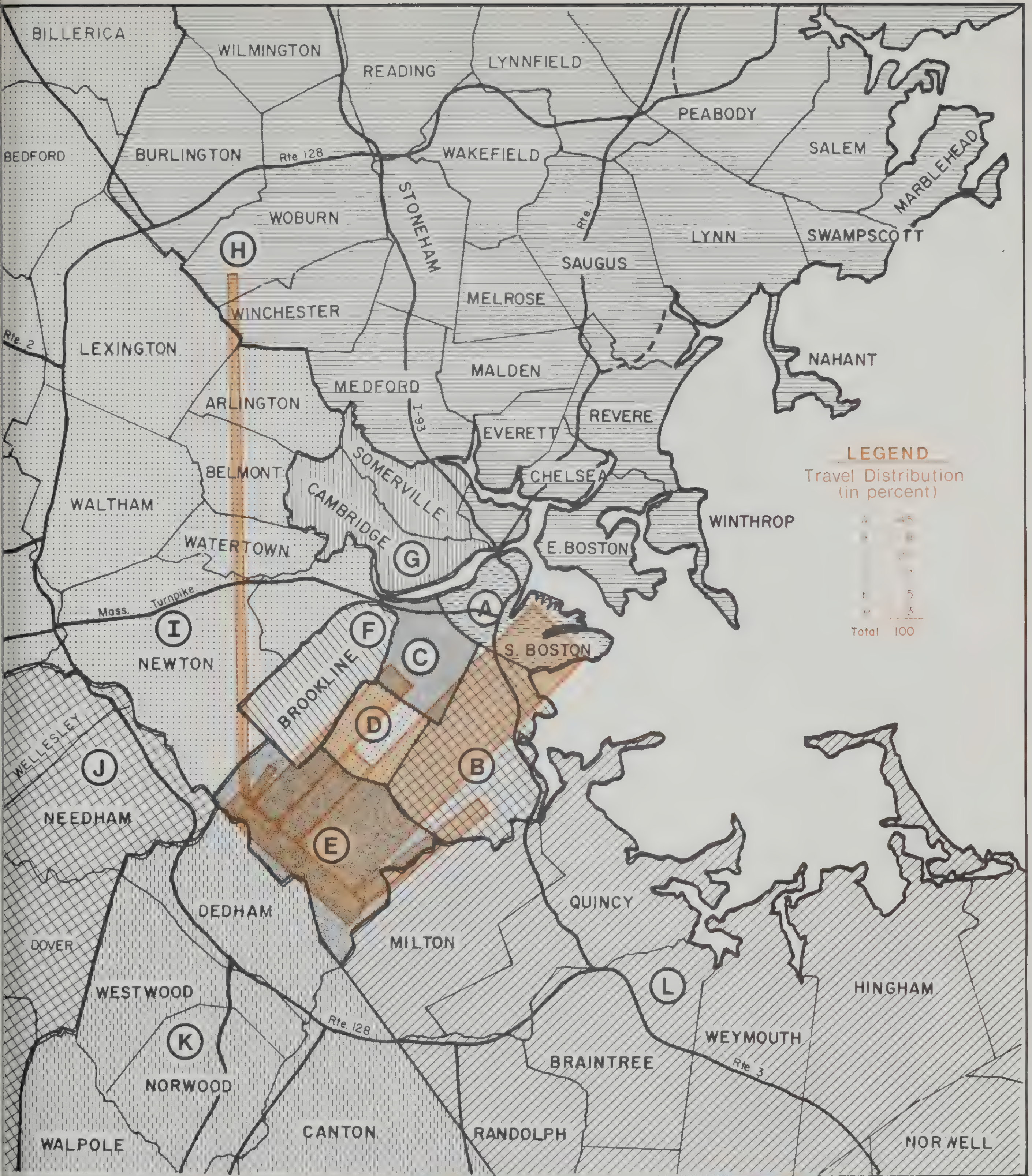
ORIGIN / DESTINATION STUDY STATION LOCATIONS

FIGURE III-13



TRAFFIC ZONES

FIGURE III-14



TRAFFIC DESIRE LINES FROM AREA E

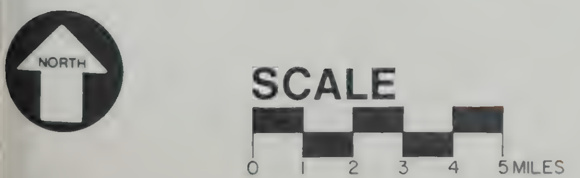
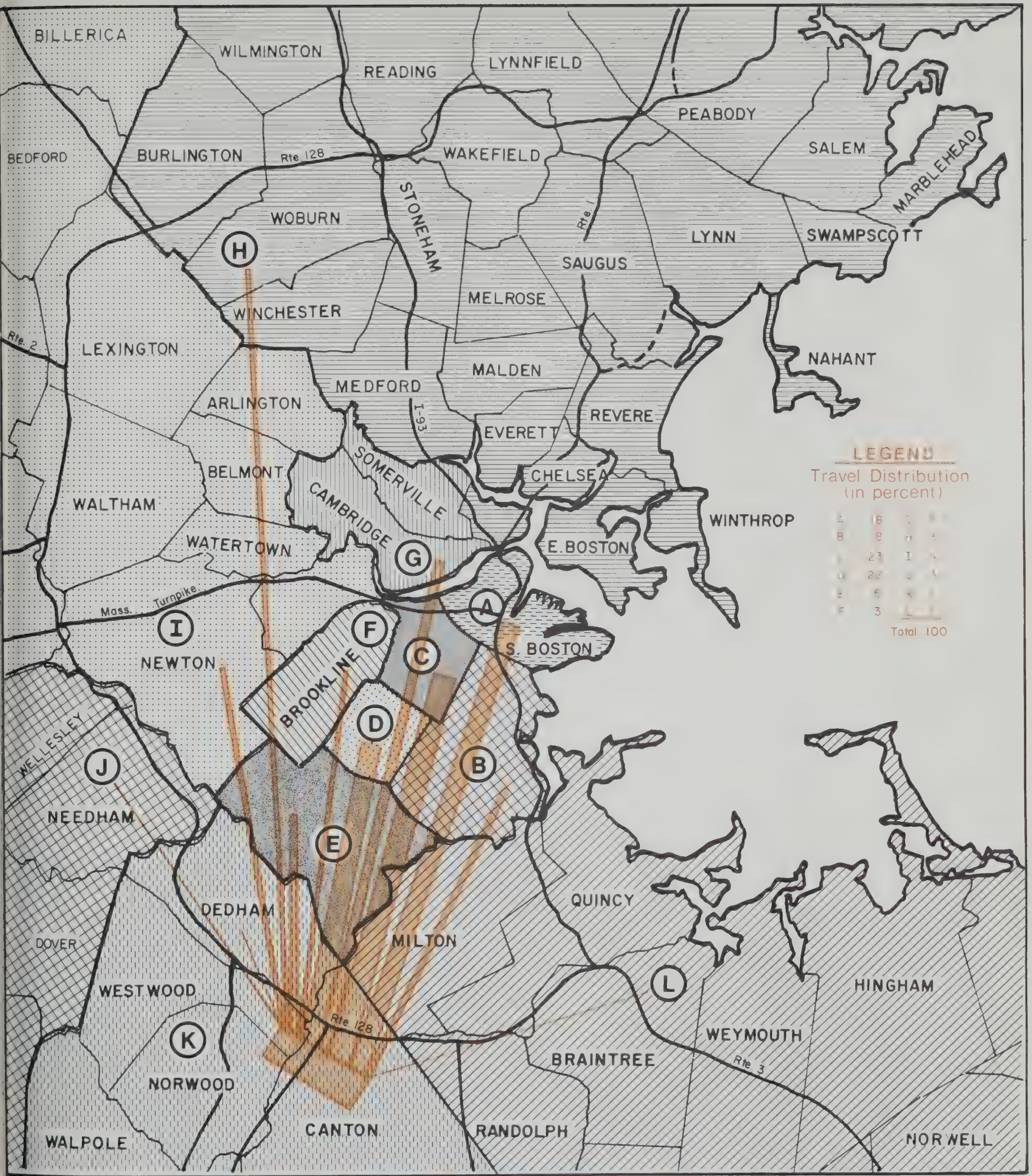


FIGURE
III–15



TRAFFIC DESIRE LINES FROM AREA K

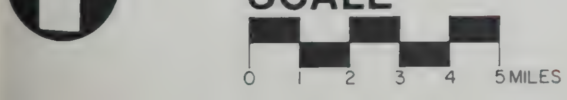
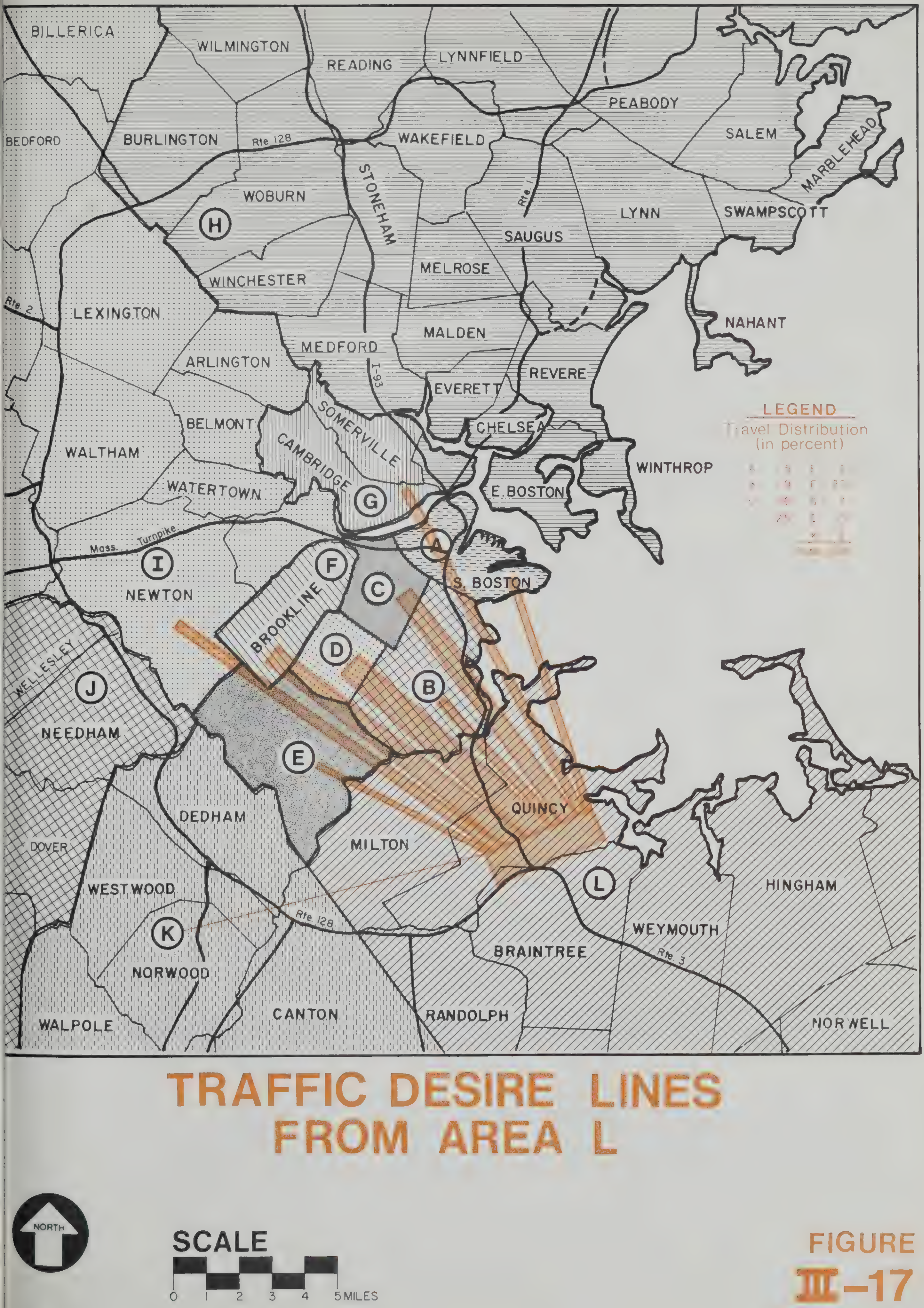


FIGURE III-16



TRAFFIC DESIRE LINES FROM AREA L

FIGURE III-17

The travel pattern of area L shows very little similarity to areas E or K. Three important movements from area L are perpendicular to the proposed arterial alignment with 20 percent of the trips destined for area F, 10 percent for area I, and another 7 percent for area G. Thus, 37 percent of the trips from area L logically use Morton Street and the Arborway as a crosstown route. Trip orientation between area L and areas C and D is also strong with 16 and 25 percent of the trips headed for these two areas respectively.

In summary, this limited origin/destination study confirms the conclusion that would be drawn from the traffic flow map. The major travel desire within the study area is a north-south orientation with a strong travel desire directed toward the Central Business District and slightly lesser travel desires for the Fenway, Back Bay, Roxbury, and Jamaica Plain areas of the city. There is also a substantial crosstown travel desire between the south shore communities and the areas west of Boston including principally Brookline, Cambridge and Newton.

3.3.4 Travel Speeds

The Southwest Corridor has few continuous radial routes into downtown Boston. The existing routes consist of combinations of arterial routes which are somewhat circuitous, but which have been analyzed for comparison with adjacent expressways. The principal arterial is comprised of the VFW Parkway, which leads into Jamaicaway and eventually to Storrow Drive. Fig. III-18 shows the comparison of this route with two routes in the Southeast Corridor - 3A/Morrisey Blvd/Dorchester Avenue, and Southeast Expressway - and two routes in the Western Corridor - Route 9 and the Massachusetts Turnpike.

(FIG. III-18)

OUTBOUND TRAVEL TIMES (Minutes) -- LEVERETT CIRCLE TO ROUTE 128

Route	Approx. Distance	Peak/Off-Peak Travel time		Daily Volume	
		1963	1971	1963	1971
3A/Morrissey Blvd./ Dorchester Avenue/ Central Artery	11.5	35/30	44/29	35,000	45,000
Southeast Expressway/ Central Artery	11.5	30/30	32/15	71,000	97,000
VFW Parkway/ Jamaicaway/ Storrow Drive	13.5	39/32	48/27	27,000	40,000
Route 9 Storrow Drive	10.5	37/31	37/24	37,000	33,000
Massachusetts Turnpike	13	-	24/16	-	55,000

A review of the changes in level of service to radial traffic in the Southwest since 1963 shows the following:

Mass. Pike construction has decongested the Route 9/Riverway/Park Drive/ Storrow Route. This is the only place in the region where volumes are down -- resulting in substantial off-peak travel time savings and slight peak hour savings.

The VFW Parkway/Jamaicaway/Storrow route has changed very little since 1964 but carries substantially greater volumes. Peak hour travel time (Leverett Circle to Route 128) has increased in the evening to approximately 48 minutes while morning peak and off-peak speeds have remained constant -- indicating a decrease in safety and an increase in driver stress.

The Southeast Expressway has undergone substantial operational improvements since 1963, including the use of breakdown lanes as travel lanes, ramp restrictions, an exclusive bus lane and a high degree of surveillance and enforcement. Despite a volume increase, evening peak speeds have not substantially changed, and remain about 22-25 miles per hour while off-peak speeds have been improved to about 45 miles per hour.

With the exception of the Massachusetts Turnpike, the average peak hour speed ranged from 18 to 22 mph. The corresponding morning peak hour speeds are slightly higher since there is less non-work traffic in the flow. In each case a deterioration of 1 to 10 minutes in the total trip time has been experienced since 1963.

Off-peak travel, however, has not deteriorated and is more subject to driver variability. Off-peak speeds from 25 to 45 miles per hour are possible, the latter on the Massachusetts Turnpike.

4

4.0 IDENTIFICATION AND DESCRIPTION OF PROJECT ALTERNATIVES

An essential element of any planning and design process is the consideration of alternative ways to achieve project objectives. The most obvious alternatives are the various project alignment and configurations dictated by engineering, structure, physical, economic and environmental consequences. Because of this, additional alternatives must be considered which approach the achievement of objectives, but which also reduce environmental impacts to an acceptable level. These include nonstructural or minimum action alternatives. Finally, the impacts of implementing the project must be assessed.

The section describes the process by which many project alternatives were identified and evaluated. In addition it describes the alternative selected for in-depth study and impact analysis.

As such it reviews the BTPR analysis which led to the basic Southwest Corridor strategy of relocating the Orange Line to the Penn Central, while proceeding simultaneously with the development of "replacement" service in the Washington Street sub-corridor, commuter rail improvements south of Forest Hill and improvements to the rail facility through Roslindale, West Roxbury and to Needham. The results of a more detailed analysis of the optimal location and configuration of the Orange Line facility is also presented as is an analysis concerning the requirements for railroad tracks in the corridor.

4.1 Background of the Planning Process

The analysis of the mass transportation alternatives in the Southwest Corridor can be usefully divided into two stages. In the first stage the regional, corridor wide need for services was examined in terms of alternative program packages comprised of various facility combinations. The methodology applied in this phase was one appropriate for a high aggregation, sketch planning study designed to allow a rapid narrowing of regional alternatives. The second stage of analysis undertook the development of one particular transit project within the context established as a result of the conclusions drawn in the first stage. A more detailed methodology was applied in this second stage.

The Boston Transportation Planning Review (BTPR) carried out the examination of regional program packages, and established a single transit strategy for major facilities in the corridor. Following the BTPR, a continuing environmental assessment process has carried on the second stage, the project specific phase, of the Corridor's transit planning activity.

4.2 Identification of Regional Alternatives

Definition of the project corridor precipitated various alternative configurations for the relocated Orange Line. Alternatives were developed for testing, with the likelihood that some would be eliminated and others which would be modified as the study process progressed. At the same time, the "technology" alternatives were grouped with other transit improvements, to identify clearly the entire system of alternatives which might be possible. The entire set of technology alternatives are briefly described in Appendix C. The transit packages which were evaluated are described in Section 4.4.1.

4.2.1 Transit Packages Evaluated

The analyses of transit packages include a series of ten facility packages with alternative technologies and levels of service for each of the radial line-haul corridors within the Southwest. A fixed total amount of transit patronage was assumed for each alternative, along with an estimate of travel time, service frequency, revenue, operating costs, capital costs, and net benefits.

Description of Transit Packages (Fig. IV-1)

Package 1. This package consists of the existing transit service to be used as a basis for comparison. Line-haul facilities include the Orange Line elevated via Washington Street to Forest Hills, and the present commuter rail services. They include four routes, all stopping at South Station and Back Bay station. The four are the Needham Branch, which merges with the mainline at Forest Hills, the Franklin Branch which merges at Readville, the Stoughton Branch which merges at Canton Junction, and the main line itself which carries commuter service as far as Providence.

Package 2. This package retains the existing Orange Line. It replaces commuter rail with dual-power vehicles which would make present commuter rail stops including Back Bay station, but would be routed via the South Cove tunnel into the downtown Orange Line subway rather than to South Station.

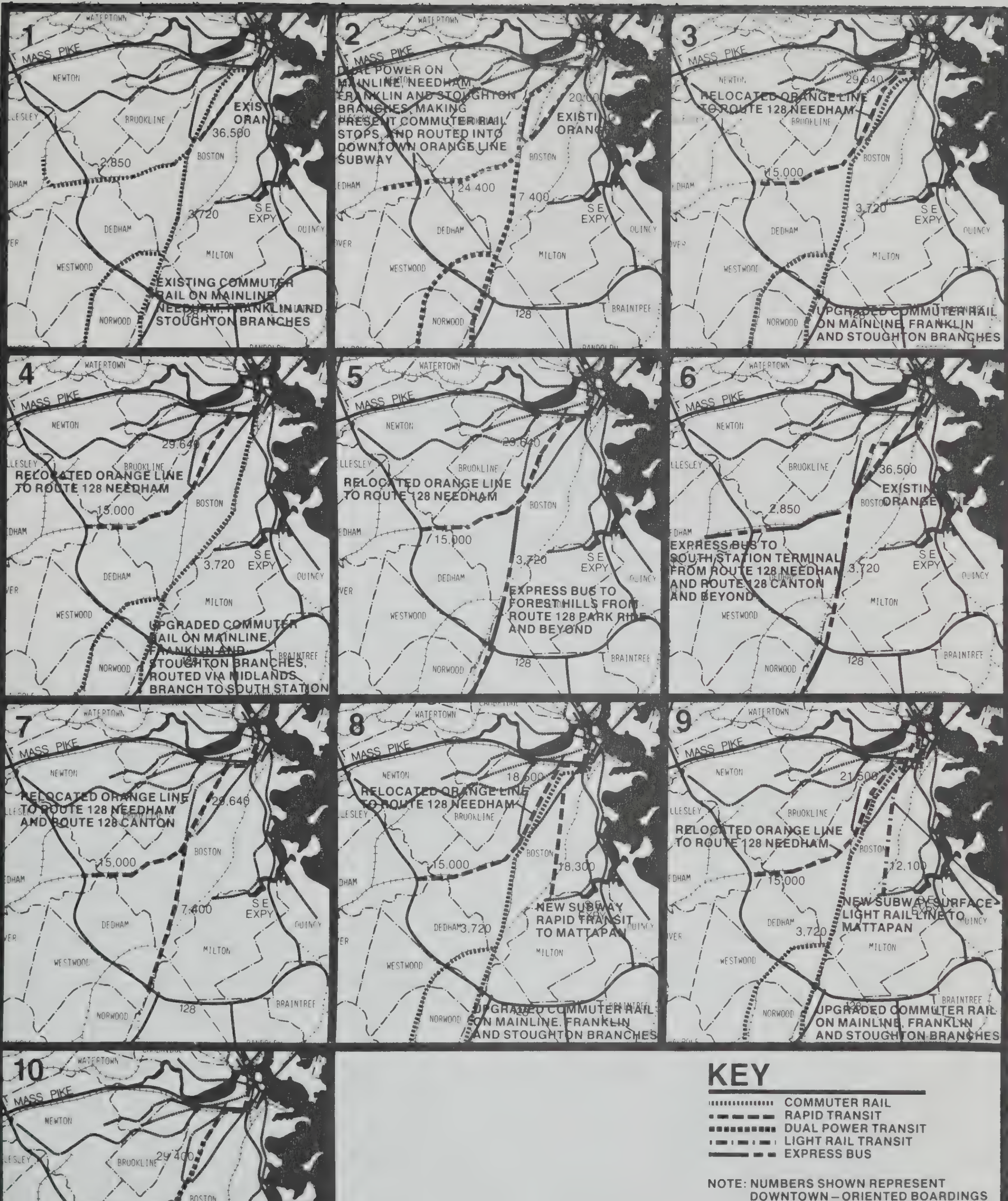
Package 3. In this package, the present Orange Line is replaced by a relocated rapid-transit line in the Penn Central main line right-of-way to Forest Hills. the rapid-transit line also extends along the Needham Branch right-of-way to Route 128, replacing that commuter rail service. The Franklin, Stoughton and mainline commuter rail services are retained and upgraded.

Package 4. Rapid transit is configured as in Package 3, but commuter rail is relocated to the Dorchester Branch of the Midlands Division, which is upgraded, including necessary trackwork, to permit a high level of service.

Package 5. Again, rapid transit is configured as in Package 3, but commuter rail is discontinued. Express buses to Forest Hills would shuttle from Route 128 park-ride and the commuter rail service area beyond. Thus the package is dependent upon highway construction south of Forest Hills.

Package 6. This package is dependent upon highway construction through the entire Corridor and discontinues commuter rail services. Express bus service would be provided between a new terminal at South Station and (a) Route 128 and I-95, and (b) Route 128 at Needham. The latter would be provided by constructing a busway in the Needham Branch rail right-of-way. The express buses would serve park-ride passengers at Route 128 and the present commuter rail service area beyond. The existing Orange Line is retained in this package.

Package 7. Commuter rail is discontinued in this package. Rapid transit is relocated to the railroad main line and extended beyond Forest Hills both to Route 128-Needham and Route 128 beyond Readville. Feeder buses would supplement park-ride for access from points outside Route 128.



PRELIMINARY TRANSIT PACKAGES FOR TESTING PURPOSES

FIG. IV–1 SOURCE: BTPR

Package 8. This package builds on Package 3 by adding a second new rapid-transit line, in subway, replacing the elevated between South Cove and Dudley and extending to Grove Hall, Franklin Park and Mattapan.

Package 9. This is a second dual power vehicle scheme, in which the rapid transit stations north and south of Forest Hills are implemented and dual power trains combine the commuter rail and inner-area rapid-transit functions. The present Orange Line is discontinued.

Evaluation of Preliminary Packages

Evaluation of the ten packages involved the following elements:

- Estimation of travel time ridership, and revenue for each line-haul condition imposed by each package.
- Estimation of appropriate service frequency and resulting operating cost for each line-haul facility based on the ridership estimates.
- Summarization of user and operator economic benefits for each package, compared with Package 1.
- Estimation of the capital cost of each package, and comparison of capital costs with economic benefits.
- Consideration of the extent to which elements in each package respond to the transit problems enumerated earlier in the report.
- Consideration of the factors influencing the analysis -- impact of improved transit productivity, marginal costing of commuter railroad service, operational and line-balance considerations for the Orange Line, public attitudes toward technologies, local service implications, institutional problems, and reliability inherent in each technology.

4.2.2 Methodology

The broad regional analysis presented in this Section is based on a simple fixed-transit trip table (ridership estimates), which was created by the "Fratar" process from 1963 transit origin-destination data. The total magnitude of transit demand does not rise and fall in correlation with the quality of supply characteristics specified by each of the modal combinations. The analysis described in Section 4.3 is based on the full application of the urban transportation planning process, with specific examination of the effect of trips which divert to transit from private transportation, and trips which are "induced" by the existence of the new facility itself. Because of the difference in methodology, the transit market descriptions presented in Section 4.2 are different in nature from the more complete descriptions provided in Section 4.3.

Evaluation measures utilized in Section 4.3 provide a more accurate simulation of trip-making behavior than the sketch-planning summaries of Section 4.4. That section examines the applicability of several possible modes to each of the general market areas by employing an index entitled "Perceived Travel Speeds". These calculations show the relative level of service quality experienced by these areas by dividing the total weighted travel time to down-town by the distance to downtown. Weighted travel times are based on in-vehicle time plus 2.5 perceived minutes for every minute of waiting time.

Ridership

The analysis of ten packages assumes a fixed transit trip table - that is, the number of trips in the Corridor via transit is assumed to be the same regardless of the improvement package considered. These are shown in Fig. IV-1 for the various subareas in the Southwest. These Corridor trips were assigned to the facilities in each package.

The oversimplification that results from assuming a constant mode split tends to understate and lessen the difference among packages. There is evidence in the later analysis, however, that the full-system sensitivity test of demand does not alter the ranking of packages.

The facilities evaluated are limited to the line-haul parts of the network, but to varying degrees, shorter local trips also are accommodated, so that the number of trips carried by any given facility being evaluated varies from one "package" to another. Further variation occurs because of differing attraction of trips at the edges of the Corridor. Finally, the facilities evaluated do not uniformly serve identical portions of each trip; passengers may board a train at Needham Junction, for example, but board at Route 128 if rapid transit is the available facility.

The analysis apportions revenues and operating costs so that fair comparisons are made despite these differences.

Travel time

Package 1 is the existing configuration of line-haul transit facilities in the Southwest and has been used as a basis for evaluation of other packages. For each, travel times have been estimated. Improvements in travel time would accrue from the following sources:

- Reduced running time due to higher performance equipment, better alignment, different station spacing, etc.
- Reduced waiting time due to improved headways.
- Reduced transfer time due to through routing, improved physical transfer conditions, or more frequent connecting services.

While overall travel time reductions give a broad measure of the amount of improvement gained by an alternative, the locations affected and the number of users in each location also are of importance. If possible, transit in areas not well served at present should be improved, to be more on a par with better-served areas, and the service level should not be reduced in any area.

The present level of service to the various subareas can be indicated by calculating peak period "behavioral time" (travel time plus a weighted indication of time spent walking or waiting which reflects the psychological response to the inconvenience). This was estimated for trips to downtown Boston, and divided by the distance from the centroid for that area to downtown. The results of this process are shown in Fig. IV-2.

FIG. IV-2

"BEHAVIORAL" TIME AND SPEED FOR SOUTHWEST SERVICE AREAS

(BTPR)

Service Area	Behavioral Travel Time to CBD* (weighted min.)	Distance to CBD (mi.)	Average Behavioral Speed (mph)
Dudley & Vicinity	25.8	3.0	7.0
Forest Hills	34.3	5.3	9.3
Roxbury Crossing	40.5	3.0	4.4
West Roxbury	67.3	7.6	6.8
Needham	77.8	10.6	8.2
Route 128 Canton	72.0	12.1	10.1
Franklin Park-Mattapan	46.5	5.2	6.8

*These travel-time estimates are consistent with one another but do not fully reflect distribution times and therefore are somewhat low.

One would expect higher speeds for the longer trips and this is generally demonstrated by the results of this analysis. The areas most in need of improved transit service on this basis are the Main Line railroad corridor, West Roxbury, Franklin Park-Mattapan, and Needham service area.

The various transit improvement alternatives affect these service areas in different ways, as illustrated by Fig. IV-3.

It is apparent that the present Orange Line corridor as far south as Dudley should have service in the future. The existing line, a new subway on or near the present alignment, a light rail surface line or an exclusive right-of-way bus could be provided. The Forest Hills area would benefit by the relocated Orange Line or the dual power vehicle; the same would be true for the Main Line corridor, the West Roxbury area, Needham, and the area that includes Readville and beyond. Express bus would improve service for West Roxbury, Needham and Readville. Either rapid transit or light rail to Mattapan would significantly improve service in the Franklin Park-Mattapan area.

These comments only apply with respect to service between each Southwest service area and downtown Boston. Alternatives that provide non-stop point-to-point service (express bus, for example), would serve no intra-corridor function, and the wider stop spacings of commuter rail and rapid transit would have less local service value then the frequent stops of light rail or local bus. Thus, Fig. IV-3 overstates the value of express bus compared to commuter rail or rapid transit. It also overstates the value of rapid transit to Mattapan in comparison with light rail.

Fig. IV-4 records the result of an analysis of user benefit which is based upon travel time. The calculations subtract net cost of each service from estimates of user benefit. User benefit is calculated by multiplying travel time saved by a fixed value of $3.00 per hour, an arbitrary though standard measure.

4.2.3 Conclusions from Regional Alternatives Testing

With the conclusion of the BTPR, a concensus was reached that the Orange Line should be relocated to the Penn Central right-of-way, with some kind of replacement service supplied to the Washington Street sub-corridor. Of the 9 alternative systems compared with the no-build case, the highest level of net benefit (defined as level of user benefit minus net increase in operating cost over increase in revenue) was attained by process alternative 9 which offered Orange Line to Needham, CRR to the South, and replacement service to Mattapan.

During this planning, a considerable effort was undertaken to seek the most appropriate technological solution to each of the market areas revealed in the sketch planning exercise. Through an extensive process, separate neighborhood representatives began to define more clearly their separate transit needs. The South End articulated a demand for locally oriented, multi-stop, on-surface service to downtown. The Roxbury community focussed on transportation needs which extend out from Dudley to the Grove Hall and Mattapan areas. Jamaica Plain focussed on the desirability of obtaining transportation benefit from a facility which bisected the community with local service.

The BTPR ended with a broadly based decision to remove the Orange Line from the elevated alignment to the Penn Central corridor, while simultaneously developing both South End replacement, and Roxbury-Mattapan services. From this basic strategy came the decision to focus on the relocated Orange Line as one major project within the corridor.

Consistent with this general corridor strategy, the South Cove to Forest Hills project was defined for detailed environmental analysis, as other corridor planning efforts were accelerated. The sections of this report which follow present the Environmental Analysis undertaken for the specific South Cove to Forest Hills to Needham, i.e. diesel powered rail electrified rail or rapid transit, are being examined in separate Envirnomental Assessment.

4.2.4 Highways

In the recent past, regional planning was noted for the emphasis it placed on highway planning. This attitude was changed in the early 1970's, when the then Governor stopped all new expressway construction within the Route 128 Perimeter for a major restudy of the Boston region's transportation needs. Following the study made by the two-year, $3.5 million Boston Transportation Planning Review (BTPR), the Governor decided not to build the radial expressways planned for the region. He decided to rely more on mass transit and rail to move people in the denser core area. The Commonwealth of Massachusetts adopted a "balanced" transportation policy, calling for a combination of transit and highway investments, planned as part of unified transportation system. The Southwest Corridor studies of the BTPR support the concept of major rapid transit commuter and inter-city rail facilities on the alignment of the Penn Central trackage, paralleled by new or modified local streets and boulevards in place of the previously planned expressway.

FIG. IV-3

PERCEIVED TRAVEL SPEEDS FOR SOUTHWEST TRANSIT ALTERNATIVES

Service Area	Improvement Alternative	Average "Behavioral Speed" (MPH)
Dudley Area	Existing R.T.	7.0
	Relocated R.T.	5.5
	Dual Power Vehicle	5.6
	Mattapan R.T.	7.0
	Light Rail	6.8
Forest Hills	Existing R.T.	9.3
	Relocated R.T.	10.1
	Dual Power Vehicle Expr.	10.6
	Dual Power Vehicle	10.2
	Express Bus	8.7
Roxbury Cros-sing/Jackson Square	Existing R.T.	4.4
	Relocated R.T.	7.5
	Dual Power Vehicle	7.6
West Roxbury	Commuter Rail	6.8
	Relocated R.T.	12.0
	Dual Power Vehicle Expr.	11.3
	Dual Pwer Vehicle	11.5
	Express Bus	10.9
Needahm	Commuter Rail	8.2
	Relocated R.T.	11.3
	Dual Power Vehicle Expr.	12.5
	Dual Power Vehicle	12.7
	Express Bus	9.4
Readville & Beyond	Commuter Rail	10.1
	Relocated R.T. Ext.	11.6
	Dual Power Vehicle Expr.	13.4
	Dual Power Vehicle	12.5
	Bus to R.T.	11.0
	Express Bus	11.7
Franklin Park/Mattapan	Existing R.T.	6.8
	Mattapan R.T.	9.5
	Mattapan Lt. Rail	8.5

Source: BTPR

FIG. IV-4

ANNUAL NET BENEFITS
OF TRANSIT PACKAGES
($ Millions)

Packages	Net Change in Cost	User Benefit	Net Benefit
2. Dual power vehicle replacing all commuter rail, existing Orange Line retained.	4.0	9.8	5.8
3. Orange Line to Route 128-Needham, commuter rail to the south via Mainline.	0.2	11.6	11.4
4. Orange Line to Route 128-Needham, Commuter rail to the south via Dorchester Branch of the Midlands Division.	0.2	11.6	11.4
5. Orange Line to Route 128-Needham, express bus from Forest Hills to Route 128 Canton	-1.5	11.7	13.2
6. Express bus from South Station to Route 128 Needham and 128-Canton, existing Orange Line.	-3.0	7.0	10.0
7. Orange Line to Route 128-Needham, Orange Line to Route 128-Canton.	0.6	11.9	11.3
8. Orange Line to Route 128-Needham, Orange Line to Mattapan.	3.2	15.0	11.8
9. *Orange Line to Route 128-Needham, commuter rail to the south, Green Line (light rail) to Mattapan.	0.1	13.9	13.8
10. Dual power vehicle replacing all commuter rail; no other line-haul transit.	0.6	11.9	11.3

Source: BTPR

*BTPR's selected Alternative Program Package

4.3 Identification of Alternatives for the Southwest Corridor

4.3.1 Transportation Analysis - Narrowing of Transit Alternatives*

4.3.1.1 Background, Purpose, and Structure of Section

This section presents an examination of the transportation costs, and the distribution of transportation benefits associated with the proposed project and its alternatives. Included are an analysis of the Rapid transit location and configuration, and an analysis of the railroad requirements.

While the transportation analysis presented is consistent with, and follows logically from the BTPR analysis, its purpose and methodological characteristics are considerably different. The BTPR transit planning was undertaken on a "sketch planning" basis which would allow a significant number of regional combinations of services to be examined simultaneously. That analysis was sufficient to derive a basic transit planning strategy for the entire corridor, including the following four elements:

- Relocation of the Orange Line to the Penn Central alignment.
- Replacement services in and extending from the general corridor from which the Orange Line is to be removed.
- High speed commuter railroad service south of Forest Hills, shared with AMTRAK facilities.
- Provision of high quality rail service through West Roxbury to the 128/Needham area.

The BTPR technical work, however, did not bring the analysis of the proposed project to a level sufficient for the Capital Grant/Environmental Impact Analysis process requirements.

Following the BTPR, the Southwest planning process has included a detailed analysis of the transportation costs and benefits associated with the proposed project. This analysis has focused on such issues as the number of rapid transit tracks, and the number of conventional railroad tracks needed in the corridor. Consistent with environmental regulations, considerable attention has been given to the transportation impacts of both the "no build" and the option of reconstructing the transit facility along (roughly) the same alignment used today by the Penn Central.

This report presents the results of detailed examination of the transportation impacts of the proposed project and its alternatives.

Three possible alignments are examined in this section in terms of ridership, user benefit, and operating costs. In order of their presentation, they are:

- The "no build" Alternative - continued use of the elevated structure.
- The Penn Central Corridor.
- The Shawmut Avenue/Washington Street Alignment.

4.3.1.2 The No-Build Alternative

4.3.1.2.1 Background

The Orange Line between Essex Station and Forest Hills is the oldest high-platform line in the MBTA rapid transit system. The section from Dudley station to a point near Herald Street north of Dover Station opened in June 1901. Originally the line pro-

*Section 4.3.1 and 4.3.2 and Appendix B were prepared by Central Transportation Planning Staff.

ceeded from there into downtown Boston via the Tremont Street subway of the Green Line. The present Washington Street tunnel and connecting ramp to the elevated at Herald Street were completed in 1908, and Orange Line cars were then diverted to this route. The final section from Dudley Station to Forest Hills station was placed in operation in November 1909.

The southern end of the Orange Line, from Dover Station to Forest Hills, has always been heavily dependent on feeder modes for collection and distribution of its riders. Currently 54 percent of the riders arrive by bus, 29 percent walk in, 14 percent park at stations and 3 percent are dropped off at stations. When the line first opened feeder service was provided by streetcar routes, many of which pre-dated the elevated. From its opening date until the late 1920's the Orange Line served most of Dorchester via connecting trolley service, but with the completion of the Red Line to Fields Corner in 1927 and to Ashmont in 1928 many of the Dorchester feeder routes were reoriented to serve the Red Line, leaving the Orange Line with a reduced service territory to the east.

4.3.1.2.2 Ridership

Basic ridership information is presented in Fig. IV.-5, and 6. The forecast for the "no build" alternative (or base case) predicts 33,320 daily northbound riders in 1980 (Fig. IV-5). This is a slight decline from current ridership, based on the fact that no travel time improvements are assumed, and that population is declining in the inner area served by the existing facility. It should also be noted that the "no-build" configuration assumes the abandonment of the existing unopened South Cove station.

FIG. IV-5

ESTIMATED INBOUND BOARDINGS AND LINE VOLUMES - "NO BUILD" SYSTEM, SOUTHWEST CORRIDOR (UNCONSTRAINED BY PARKING CAPACITIES) 1/5/76.

	1980 Peak Period[1]			1980 24-Hour			1995 24-Hour		
Station	Boardings	Offs	Line Vols	Boardings[2]	Offs[3]	Line Vols	Boardings	Offs	Line Vols[4]
Forest Hills	8094	0		13760	0		14850	0	
			8094			13760			14850
Green Street	776	13		1860	35		1825	35	
			8857			15585			16640
Egleston	1700	77		3660	210		3555	200	
			14480			19035			19995
Dudley	3810	502		8390	1045		8090	1010	
			13788			26380			27075
Northampton	1214	585		3450	1665		3385	1645	
			14417			28165			28815
Dover	550	1120		2200	2150		2270	2125	
Total	16144	2297	13847	33320	5105	28215	33975	5015	28960

1. Peak period is 7 AM to 10 AM
2. Inbound boarding passengers
3. Inbound alighting passengers
4. Inbound line segment (station to station) volume

FIG. IV-6

ESTIMATED UNCONSTRAINED STATION BOARDINGS BY ACCESS MODE AND ZONES OF ORIGIN - "NO BUILD" SYSTEM, SOUTHWEST CORRIDOR 1/5/76

Station Name: Forest Hills
Alternative: No Build

City or Town or Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Brookline	0	84	87	21	192	288	300
Canton	0	0	0	54	54	65	83
Dedham	0	326	41	342	709	922	996
Dorchester	0	224	22	39	285	482	472
Dover	0	0	0	85	85	102	122
Foxborough	0	0	0	68	68	75	84
Hyde Park	0	950	70	140	1160	2090	2257
Jamaica Plain	676	403	22	20	1121	2281	2240
Medfield	0	0	0	80	80	96	119
Millis	0	0	0	14	14	17	22
Milton	0	0	0	63	63	82	87
Needham	0	0	0	137	137	178	194
Newton	0	0	3	17	20	26	27
Norwood	0	143	10	225	378	492	550
Randolph	0	0	0	15	15	18	25
Roslindale	81	1605	76	58	1820	3458	3804
Roxbury	2	10	0	0	12	20	19
Sharon	0	0	0	16	16	19	21
Sherborn	0	0	0	16	16	19	31
Walpole	0	0	0	75	75	90	115
West Roxbury	0	1097	75	104	1276	2297	2481
Westwood	0	250	10	195	455	591	739
Other	0	0	8	35	43	52	62
Total	795	5092	424	1819	8094	13760	14850

Station Name: Green Street
Alternative: No Build

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Jamaica Plain	680	69	10	17	776	1860	1825
Total	680	69	10	17	776	1860	1825

Station Name: Egleston
Alternative: No Build

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Dorchester	0	386	66	0	452	970	952
Jamaica Plain	507	87	0	0	594	1280	1252
Roxbury	525	123	6	0	654	1410	1351
Total	1032	596	72	0	1700	3660	3555

FIG. IV-6 (Continued)

ESTIMATED UNCONSTRAINED STATION BOARDINGS BY ACCESS MODE AND ZONES OF ORIGIN - "NO BUILD" SYSTEM, SOUTHWEST CORRIDOR 1/5/76

Station Name: Dudley
Alternative: No Build

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Dorchester	0	424	0	0	424	930	910
Jamaica Plain	51	0	0	0	51	110	108
Parker H/Fen	0	115	0	0	115	250	252
Roxbury	862	2262	96	0	3220	7100	6820
Total	913	2801	96	0	3810	8390	8090

Station Name: Northampton
Alternative: No Build

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Boston Proper	446	3	0	0	449	1280	1320
Dorchester	0	38	0	0	38	90	88
Parker H/Fen	0	16	0	0	16	46	47
Roxbury	325	20	0	0	345	990	950
South Boston	49	317	0	0	366	1044	990
Total	820	394	0	0	1214	3450	3395

Station Name: Dover
Alternative: No Build

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Boston Proper	550	0	0	0	550	2200	2270
Total	550	0	0	0	550	2200	2270

4.3.1.2.3 User Benefit

This alternative served as the base against which the other two alternatives are observed. No "absolute value" of the present service is calculated in this comparative method.

4.3.1.2.4 Operating Costs

The present Orange Line south of Essex has the highest unit operating and maintenance costs of all existing MBTA rapid transit lines as a result of its location on elevated structure. Although station spacing all along the Washington Street elevated averages from one-half to one mile, maximum train speed has always been restricted to 40 mph for safety reasons. In addition to this general speed restriction it has been necessary to impose temporary restrictions at various points where structural defects have been found, until these could be repaired. Because of these limited speeds, the average wages per car mile for train motormen and

guards are 20 to 30 percent higher on the Orange Line than on the Blue Line or the Cambridge-Dorchester portion of the Red Line. (The South Shore extension of the Red Line is not relevant for comparison here because it contains a long section of express tracks.)

The elevated structure between Herald Street and Dudley Station is 74 years old and the balance of the structure is 66 years old. The older structure employs a lattice girder design that was considered obsolete by many engineers even at the time of construction due to its relatively low strength. The later structure south of Dudley is stronger than the original elevated because an improved design was used. Due to budgetary constraints, maintenance of the elevated structure itself in past years was inadequate to offset the effects of train loadings plus harsh New England weather. Consequently, major rehabilitation is now necessary to keep the structure usable at least until a relocated line is built. If the "no build" option is selected, more permanent repairs will be required, and annual maintenance expenditures will have to be increased in order to prevent a recurrence of the present deterioration. Further, in the "no build" option the cost of the existing South Cove tunnel (valued at 13.3 million in 1968) would be a fixed cost of that course of action.

Track maintenance costs per mile are approximately twice as high on the Orange Line elevated as anywhere else on the MBTA rapid transit system. This is an inherent problem of elevated lines of this design due to the complex system of rail and tie fastenings required, and to hazardous working conditions.

4.3.1.3 The Penn Central Alignment

4.3.1.3.1 Background

The proposed Southwest Corridor alignment for the Orange Line relocation follows the route of the former Boston and Providence Railroad, which was opened from Park Square Boston to Readville in 1834 and to Providence, Rhode Island in 1835. As originally built the Boston and Providence crossed several streets at grade north of Forest Hills. The tracks were raised to the present embankment between Forest Hills and Northeastern University in the late 1890's

During the 1880's and 1890's extensive commuter services were established on most of the rail lines radiating from Boston. Service on several lines included turnback points less than ten miles from downtown Boston. Although these commuter rail operations provided much more frequent service than had previously been operated, most of them did not come close to matching frequencies of street railway and rapid transit services which began not long afterwards. This, combined with the automobile resulted in the demise of most of the short turn commuter rail services by 1920.

Following the opening of South Station in 1899 the intown terminal was shifted there from Park Square and a stop was added at the new Back Bay Station. Old New Haven Railroad schedules show that the original frequencies were still in effect in 1901 when the elevated opened to Dudley, but that by 1906 mid-day headways had been increased to 30 minutes. By 1912, three years after completion of the elevated to Forest Hills, the commuter rail turnback at Forest Hills had disappeared entirely. Dedham service had been somewhat reduced, and stations between Forest Hills and Back Bay were being served by Dedham trains.

The Boston and Providence alignment offers a unique opportunity to improve the quality of the Orange Line without the necessity of major new land taking. From an operations standpoint, relocation on the Boston and Providence would permit operating speeds limited for all practical purposes only by station spacing and equipment performance characteristics. With well-maintained track the speed limit for passenger trains between Forest Hills and Northeastern University is 80 to 90 mph. This is far beyond the requirements of rapid transit which would probably have a top speed of 60 mph.

The Relocated Orange Line alignment was included as part of the first priority "action program" in the 1966 Program for Mass Transportation, and the 1969 EMRPP Highway and Transit Plan. The alignment decision was re-affirmed in the 1972 BTPR study, and is included in the present "Transportation Improvement Plan".

4.3.1.3.2 Ridership Characteristics

Ridership forecasts for this alignment are summarized in Fig. IV-8, and 9.

The Orange Line relocated to the Penn Central alignment would carry substantially more riders than the no-build alternative. Its 1980 daily inbound ridership is estimated to be 55,565 (Fig. IV-8) as opposed to 33,320 for the "no build" (Fig. IV-5). The significant increase in daily ridership stems directly from the alignment through the Back Bay area. This alignment contributes to ridership both from the Southwest, and from othe points in the network which benefit from the improved downtown distribution provided by the relocated Orange Line.

FIG. IV-8

ESTIMATED INBOUND BOARDINGS AND LINE VOLUMES - "RELOCATED" SYSTEM, SOUTHWEST CORRIDOR (UNCONSTRAINED BY PARKING CAPACITIES) 2/23/76

	1980 Peak Period			1980 24-Hour			1995 24-Hour		
Station	Boardings	Offs	Line Vols	Boardings	Offs	Line Vols	Boardings	Offs	Line Vols
Forest Hills	8594	0		14585	0		15780	0	
			8594			14585			15780
Green Street	969	13		2330	35		2285	35	
			9550			16880			18030
Boylston	879	46		2110	115		2070	115	
			10383			18875			19985
Jackson Square	2530	161		6580	400		6380	400	
			12752			25055			25965
Roxbury Crossing	2131	256		5330	640		5190	630	
			14627			29745			30525
Ruggles Street	2325	235		7680	590		7500	580	
			16717			36835			37445
Mass. Avenue	1219	504		3650	1260		3630	1250	
			17432			39225			39825
Back Bay	1245	2540		8715	3810		9150	4000	
			16137			44130			44975
South Cove	917	1397		4585	3710		4725	3820	
TOTAL	20809	5152	15657	55565	10560	45005	56710	10830	45880

FIG. IV-9

ESTIMATED UNCONSTRAINED STATION BOARDINGS BY ACCESS MODE AND ZONES OF ORIGIN - "RELOCATED" SYSTEM, SOUTHWEST CORRIDOR 2/23/76

Station Name: Forest Hills
Alternative: Relocated

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Brookline	0	89	94	24	207	310	324
Canton	0	0	0	60	60	72	92
Dedham	0	350	43	370	763	992	1072
Dorchester	0	230	24	42	296	500	490
Dover	0	0	0	92	92	113	133
Foxborough	0	0	0	69	69	76	85
Hyde Park	0	986	83	155	1224	2200	2376
Jamaica Plain	690	406	22	20	1138	2310	2274
Medfield	0	0	0	81	81	97	120
Millis	0	0	0	14	14	17	22
Milton	0	0	0	65	65	85	90
Needham	0	0	0	150	150	195	213
Newton	0	0	3	18	21	27	28
Norwood	0	145	10	227	382	497	557
Randolph	0	0	0	15	15	18	25
Roslindale	90	1760	86	65	2001	3802	4183
Roxbury	3	11	0	0	14	23	22
Sharon	0	0	0	17	17	20	22
Sherborn	0	0	0	17	17	20	32
Walpole	0	0	0	80	80	96	123
West Roxbury	0	1165	80	115	1360	2430	2640
Westwood	0	265	11	207	483	630	790
Other	0	0	9	36	45	55	67
Total	783	5407	465	1939	8694	14585	15780

Station Name: Green Street
Alternative: Relocated

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Jamaica Plain	827	112	11	19	969	2330	2285
Total	827	112	11	19	969	2330	2285

FIG. IV- 9 (Continued)

ESTIMATED UNCONSTRAINED STATION BOARDINGS BY ACCESS MODE AND ZONES OF ORIGIN - "RELOCATED" SYSTEM SOUTHWEST CORRIDOR 2/23/76

Station Name: Boylston Street
Alternative: Relocated

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Dorchester	0	0	26	0	26	62	60
Jamaica Plain	793	0	36	0	829	1990	1954
Roxbury	24	0	0	0	24	58	56
Total	817	0	62	0	879	2110	2070

Station Name: Jackson Square
Alternative: Relocated

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Dorchester	0	231	0	0	231	600	590
Jamaica Plain	303	408	20	0	731	1900	1860
Parker H/Fen	3	76	0	0	79	205	210
Roxbury	99	1304	86	0	1489	3875	3720
Total	405	2019	106	0	2530	6580	6380

Station Name: Roxbury Crossing
Alternative: Relocated

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1989 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Dorchester	0	268	0	0	268	670	660
Parker H/Fen	294	163	0	0	457	1145	1155
Roxbury	62	1218	126	0	1406	3515	3375
Total	356	1649	126	0	2131	5330	5190

Station Name: Ruggles Street
Alternative: Relocated

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1989 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Dorchester	0	40	10	0	50	175	170
Parker H/Fen	430	219	20	0	669	2340	2370
Roxbury	101	1427	78	0	1606	5615	5390
Total	531	1686	108	0	2325	8130	7930

FIG. IV- 9 (Continued)

ESTIMATED UNCONSTRAINED STATION BOARDINGS BY ACCESS MODE AND ZONES OF ORIGIN - "RELOCATED" SYSTEM, SOUTHWEST CORRIDOR 2/23/76

Station Name: Massachusetts Avenue
Alternative: Relocated

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Boston Proper	264	233	20	0	517	1550	1600
Dorchester	0	121	20	0	141	420	410
Parker H/Fen	53	14	0	0	67	200	205
Roxbury	74	205	15	0	294	880	845
South Boston	0	185	15	0	200	600	570
Total	391	758	70	0	1219	3650	3630

Station Name: Back Bay
Alternative: Relocated

City or Town of Origin	7-10 AM Inbound Boardings Walk	Trans fer*	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Boston Proper	540	705	0	0	1245	8715	9150
Total	540	705	0	0	1245	8715	9150

*Transfer from Penn Central Commuter Rail

Station Name: South Cove
Alternative: Relocated

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Boston Proper	766	151	0	0	917	4585	4725
Total	766	151	0	0	917	4585	4725

4.3.1.3.3 User Benefit[1]

New riders would be drawn to the system because they would save travel time. Riders who use the Orange Line regularly would benefit from travel-time reductions. All in all, travel-time savings would substantially exceed any travel-time increases for that portion of the line affected. Using a time value of $3.00 per hour, net savings to users from the south would amount to $3.7 million per year if the Orange Line were relocated on the Boston Providence alignment. In addition to these user benefits, the relocated line would provide improved access to the areas around Back Bay South Cove for riders originating on the Orange Line north of Boston, from the Red and Blue Lines, from the Boston and Maine commuter and from the Green Line at Lechmere. As a result of the South Cove Extension Project, distribution of downtown riders would be improved for railroad passengers. The total bene-

[1] For an explanation the "user benefit" methodology see Appendix C.

fits accruing to these riders would amount to $1.1 million per year. The sum of benefits discussed above amounts to $4.8 million per year. These do not take into account any measures that might be taken to offset net travel time increases for riders from east of the existing Orange Line. Due to the relatively long spacing between Essex, Dover, Northampton, and Dudley stations, a substantial portion of the present users of Dover and Northampton would be better served by frequent surface transportation on Washington Street to downtown than by the existing Orange Line. Although the running speed of such service would be slower than that of the Orange Line, stops would be much more closely spaced and therefore access time for the average user would decrease. This concept is presented in detail in the "comparative analysis section", later in this report.

4.3.1.3.4 Operating Costs[1]

Due to elimination of costly maintenance problems on the elevated line and higher productivity of trainmen, the relocated line would reduce annual operating and maintenance expenses on the Orange Line by an estimated $1.3 million per year based on 1974 unit costs. The increased demand for the new location would not affect the frequency of service required, because volumes on the Washington Station to Oak Grove portion of the line would control scheduling considerations at all times when frequency was controlled by train capacity. Assuming a one-way fare of $0.25, the increased demand for the relocated line would increase Orange Line revenues by 3.2 million per year compared to revenues for the existing line in 1980.

A prime consideration in the analysis of operating costs is the possibility of providing an express track. The primary benefit of an express track would be lower costs resulting from more efficient use of manpower and equipment in meeting demand. Assuming that the express track were in service three hours each morning and three hours each evening in the peak direction five days a week, annual operating costs would be reduced by $0.4 mil. per year compared to a full local service. This would be accompaniedby a net user disbenefit of $0.24 million per year. The reason for this is that an express plus local service would result in increased wait time for most riders, and this would not be offset by running time savings for express riders. The greatest potential savings would be in rolling stock capital cost. The express plus local service option would require four fewer four-car trains than would the full-local service. At a cost of $500,000 per car in addition to the capital cost of tracks, signals, power, right-of-way, etc., the total saving would be $3 million.

4.3.1.4 The Shawmut/Washington Tunnel Alternative

4.3.1.4.1 Background (Fig. IV. 12 and 13)

As noted previously, the BTPR analysis of possible facility combinations at a regional scale studied the option of leaving the Orange Line in its present alignment, with low capital improvements along the Penn Central corridor. That study ultimately rejected the low-capital options then under consideration, and concluded that electrified transit service should indeed be placed in the Penn Central corridor, with some replacement, private right-of-way at-grade transit to be supplied in parts of the Washington Street corridor.

[1]For an explanation of operating cost methodology see Appendix C.

In the planning process undertaken for this environmental assessment, study participants have requested further information concerning a Shawmut/Washington Street location as an alternative to the relocated alignment for the Orange Line. This is partly based on a feeling that project costs for the relocated facility are higher than expected during the BTPR, and that this might affect the 1971 decision to drop the Shawmut/Washington option.

Therefore, this section of the report examines this option in terms of patronage, user benefit and operating costs.

The maximum running speed in this tunnel option would be about 55 mph, subject to restriction by station spacing, compared to 40 mph on the elevated. This combined with elimination of speed restrictions imposed due to structural defects on the elevated would result in a running time saving for the subway of 4.5 minutes between Forest Hills and Washington Station, including a stop at South Cove.

FIG. IV-12

ESTIMATED INBOUND BOARDINGS AND LINE VOLUMES - "SHAWMUT AVENUE SUBWAY", SOUTHWEST CORRIDOR (UNCONSTRAINED BY PARKING CAPACITIES) 1/5/1976

	1980 Peak Period			1980 24-Hour			1995 24-Hour		
Station	Boardings	Offs	Line Vols	Boardings	Offs	Line Vols	Boardings	Offs	Line Vols
Forest Hills	8501	0	8501	14450	0	14450	15600	0	15600
Green Street	840	15	9326	2020	40	16430	1980	40	17540
Egleston	1797	81	11042	3865	220	20075	3765	210	21095
Dudley	3910	515	14437	8620	1070	27625	8310	1035	28370
Northampton	1246	600	15083	3540	1710	29455	3485	1690	30165
Berkeley	742	1150	14675	3710	2260	30905	3820	2330	31655
South Cove	917	1397		4585	2795		4725	2880	
Total	17953	3758	14195	40790	8095	32695	41685	8185	33500

FIG. IV-13

ESTIMATED UNCONSTRAINED STATION BOARDINGS BY ACCESS MODE AND ZONES OF ORIGIN - "SHAWMUT AVE SUBWAY" SYSTEM, SOUTHWEST CORRIDOR 1/5/76

Station Name: Forest Hills
Alternative: Shawmut Avenue Subway

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Brookline	0	88	92	22	202	303	316
Canton	0	0	0	57	57	69	88
Dedham	0	344	43	360	747	971	1049
Dorchester	0	243	24	42	309	523	512
Dover	0	0	0	90	90	108	129
Foxborough	0	0	0	69	69	76	85
Hyde Park	0	980	74	147	1201	2161	2330
Jamaica Plain	685	405	22	20	1132	2300	2256
Medfield	0	0	0	80	80	97	120
Millis	0	0	0	14	14	17	22
Milton	0	0	0	65	65	85	90
Needham	0	0	0	144	144	187	204
Newton	0	0	3	18	21	27	28
Norwood	0	145	10	227	382	497	557
Randolph	0	0	0	15	15	18	25
Roslindale	88	1743	83	63	1977	3756	4132
Roxbury	2	11	0	0	13	21	20
Sharon	0	0	0	17	17	20	22
Sherborn	0	0	0	17	17	20	32
Walpole	0	0	0	79	79	95	121
West Roxbury	0	1155	79	110	1344	2419	2613
Westwood	0	264	11	206	481	625	782
Other	0	0	9	36	45	55	67
Total	775	5378	450	1898	8501	14450	15600

Station Name: Green Street
Alternative: Shawmut Avenue Subway

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Jamaica Plain	736	75	11	18	840	2020	1980
Total	736	75	11	18	840	2020	1980

Station Name: Egleston
Alternative: Shawmut Avenue Subway

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Dorchester	0	408	70	0	478	1030	1010
Jamaica Plain	536	92	0	0	628	1350	1325
Roxbury	555	130	6	0	691	1485	1430
Total	1091	630	76	0	1797	3865	3765

FIG IV- 13 (Continued)

ESTIMATED UNCONSTRAINED STATION BOARDINGS BY ACCESS MODE AND ZONES OF ORIGIN - "SHAWMUT AVE SUBWAY" SYSTEM, SOUTHWEST CORRIDOR 1/5/76

Station Name: Dudley
Alternative: Shawmut Avenue Subway

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Dorchester	0	435	0	0	435	953	934
Jamaica Plain	52	0	0	0	52	115	113
Parker H/Fen	0	118	0	0	118	272	275
Roxbury	885	2319	101	0	3305	7280	6988
Total	937	2872	101	0	3910	8620	8310

Station Name: Northampton
Alternative: Shawmut Avenue Subway

City of Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Boston Proper	457	3	0	0	460	1312	1352
Dorchester	0	40	0	0	40	95	93
Parker H/Fen	0	17	0	0	17	49	50
Roxbury	333	21	0	0	354	1016	975
South Boston	50	325	0	0	375	1068	1015
Total	840	406	0	0	1246	3540	3485

Station Name: Berkeley
Alternative: Shawmut Avenue Subway

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Boston Proper	742	0	0	0	742	3710	3820
Total	742	0	0	0	742	3710	3820

Station Name: South Cove
Alternative: Shawmut Avenue Subway

City or Town of Origin	7-10 AM Inbound Boardings Walk	Bus	Kiss	Park	1980 Peak Total	1980 24 Hr. Total	1995 24 Hr. Total
Boston Proper	766	151	0	0	917	4585	4725
Total	766	151	0	0	917	4585	4725

4.3.1.4.2 Ridership Characteristics

Detailed ridership information is presented in Fig. IV-12 and 13. One-way daily ridership for this alternative in 1980 is predicted to be 40,790 (Fig. IV-12) compared to 33,320 for the "no build" option and 55,565 for the Penn Central alignment. Because the subway retains stations in approximately their existing locations south of Dover, increased demand at these stations is a result of running time reduction rather than of providing service to new markets. Although the running time savings to downtown for the subway would be greater than those for the Southwest relocation at all stations south of Massachusetts Avenue and equal at Massachusetts Avenue, the alternative does not create an expanded market area as successfully as the relocation alternative.

4.3.1.4.3 User Benefit

The Shawmut/Washington tunnel alternative would have travel time savings of $3.1 million per year compared to the "no build" option for trips originating south of Washington Street. In addition, trips from the Orange Line north of Washington and from other lines using South Cove station as a distributor would have user benefits of $0.3 million per year. Total user benefits of the project would thus be $3.4 million compared to $4.8 million for the Southwest relocation. Orange Line revenue would increase by $1.1 million per year with the subway compared to an increase of $3.2 million for the Southwest relocation.

4.3.1.4.4 Operating Costs

The estimated operating and maintenance expenses for this alternative would be $2.0 million per year less than those of the "no build" option based on 1974 unit costs. This is $0.7 million per year more than the savings for the Penn Central relocation, due to shorter mileage, shorter running time and fewer stations. However, this savings is less than either the increase in revenue or the increase in user benefit for the relocation compared to the subway. The subway would not reduce rolling stock requirements compared to the Penn Central relocation.

4.3.1.5 Comparative Analysis of Alternatives

The preceeding descriptions have established the basic aggregate description of the transportation services to be provided by each of the three alternative Orange Line configurations. This section presents a summary description of the differences in transportation service areas and levels of service provided to the separate community sub-areas of the Corridor. This data provides the basis not only for the Orange Line location, but for further Southwest Corridor transit planning activities.

As revealed in previous sections and summarized in Fig. IV-15 the Penn Central alignment provides the highest level of ridership and user benefit of the three alternatives. This superiority in transportation service sense arises from the fact that the "relocated" configuration performs transportation services above and beyond the carrying of Corridor riders to the older, traditional section of the Central Business District. By arching over to the Back Bay area, and then continuing to the retail core, the relocated Orange Line distributes Southwest Corridor riders destined for the Back Bay, as well as transit riders from the rest of the radial transit network through the South Cove, Park Plaza, and Back Bay areas. Increased distribution possibilities would be available to railroad passengers at Back Bay station.

FIG. IV-15

COMPARISON OF ALTERNATIVES

	Estim. 1980 North-bound Dialy Riders	Estim. 1980 increased revenue*	Estim. yearly user benefit*	Estimated yearly operating cost saving* (in 1974 dollars)
No build	33,320	-	-	-
Penn Central Alignment	55,565	$3.2 mill.	$4.8 mill.	$1.3 million
Shawmut/Washington Alignment	40,790	$1.1 mill.	$3.4 mill.	$2.0 million

*As compared with no build

4.3.1.5.1 Ridership Comparison - North of Massachusetts Avenue

This combination of functions, (radial service plus distribution within the center of the network) accounts for some of the difference in the make-up of transportation services provided by the Penn Central alignment when compared with the other two alternatives tested.

Concerning the distribution function, the forecasts show that the relocated alignment provides service to some 13,000 riders (26,000 daily trips) who board at Back Bay and South Cove stations, neither of which exists in the "no build" configuration. Approximately 4,000 of these riders would get South Cove service in the Shawmut/Washington alternative, leaving nearly 9,000 riders to find other ways to the Back Bay area. As stated previously, travel time user benefits for downtown distribution riders are valued at $1.1 million per year over the base case for the relocated alignment versus $.3 million for the Shawmut/Washington alignment over the base case ("no build").

The core area configuration of the relocated alignment serves a land area with considerably higher transit trip making than does the Shawmut/Washington alignment. Specifically, within Boston Proper, (i.e., north of Massachusetts Avenue) the three stations of the relocated alignment would attract some 26,000 daily boardings, while the alternative routing would attract approximately 18,500. This superiority of core distribution holds true both for riders originating in the Southwest sector of the region, as well as for those approaching from other corridors. More than 8,800 Southwest northbound riders would get off at the inner 3 stations in the relocated alignment, versus about 6,800 in the Shawmut/Washington alternative.

By comparison, the "no build" alternative would have neither Back Bay service nor South Cove service. Boardings in the comparable land area, (north of Massachusetts Avenue, south of Essex station) are forecast at 9,500 daily revenue boardings in the "no build" compared with 18,500 for the Shawmut/Washington alternative and 26,000 for the relocated alignment. Because the already-constructed South Cove station would not be used in the "no build" alternative, the data is not totally comparable.

4.3.1.5.2 Ridership-South of Massachusetts Avenue

After the increment attributable to better core destination routing, the second major element in the higher ridership of the relocated alignment comes from the Jamaica Plain community. The market area for the proposed facility expands considerably to the west, covering much of Jamaica Plain. The network simulations show that some 4,000 Jamaica Plain and Parker Hill riders will save travel time by using the relocated Orange Line instead of the in-street operated Arborway Line. For many of these zones, the resulting travel time savings are considerable. A more complete discussion of the distribution of benefit and disbenefit resulting the Orange Line relocation is presented below.

The southern-most stations on the line experience travel time savings and consequent ridership growth in both the Shawmut/ Washington tunnel option and the relocation alignment when compared with the base case. The ridership on the Shawmut/Washington facility would be comprised of slightly fewer Back Bay destined riders, and a somewhat greater number of retail core riders, based on the relative service levels offered.

As noted, the relocated Orange Line would offer significantly improved transit service to several thousand Jamaica Plain residents who would otherwise use the Arborway streetcar service. The effect on ridership for other lines is more complex. Concerning the Red Line, fewer than 1,000 daily riders would be diverted from the southern segment of Red Line system, primarily the Mattapan extension. Analysis reveals these riders to be largely Hyde Park users with Back Bay and Fenway destinations. However, when compared with the existing system, fewer than 1,000 riders would divert to the Inner Red Line stations. These are largely Roxbury and North Dorchester riders whose feeder bus routes allow connections to both the Orange Line and Red Line.

In addition to the Arborway diversions, the relocated Orange facility would attract some 5,500 one-way riders away from the "choke point" of the Green Line, between Copley and Park Street. The need for relief in this one small segment of Green Line system has been documented in several studies, most notably the MBTA's Central Area Systems Study, in 1969. That study examined the need for a third east-west downtown tunnel (i.e., in addition to the Relocated Orange Line) and concluded that an upgraded Green Line would be sufficient provided the CBD distribution function was shared with the Back Bay routing of the Orange Line.

The preceding paragraphs have dealt with the absolute magnitude and the make-up of the ridership for the three configuration options tested in the Environmental Assessment process. A more precise tool for analyzing the impact of a proposed transportation facility is the examination of the redistribution of travel times and service levels as a result of facility investment. The following section deals not with the absolute number of individuals using a facility, but rather with the differing service impacts experienced by the separate geographic market segments of the community.

4.3.1.5.3 User Benefit Comparisons

Of the three alignments examined in this study the Relocated Orange Line produces $4.8 million of user benefit to the system over the base case, compared with $3.1 for the subway alternative along the Shawmut and Washington Street. (The "no

build is the base case.) This section will examine in detail the geographic distribution of benefits associated with the two "build" alternatives.

The geographic market area receiving travel time benefit from a full tunnel alternative under Shawmut Avenue and Washington Street is virtually the same market area served at present. Examination of ridership composition for this alternative shows very little diversion from competing transit lines when compared with base system. However, the more South Cove riders would use the Orange Line this alignment alternative than in the base case. The transportation impact of this alternative takes the form, then, of line haul time improvements brought about by the tunnel. These benefits would fall directly on the zones now using the Orange Line. No one particular area would suffer disbenefit, with the exception of the area immediately surrounding the existing Dover Street station. Increased levels of benefit would be spread rather uniformly throughout the existing service area, with increasing increments of service improvements occurring with increasing distance from downtown.

By contrast, analysis of the relocated Orange Line's transit service impacts in some detail is considerably more complex. When taken alone, (i.e., with no provisions for "replacement" services) the redistribution of transit travel time benefits (and disbenefit) is pronounced. The following paragraphs will show the change in user-benefits which would occur with relocation of the Orange Line with no replacement service assumed. Then, the data will be used to show level of user benefit resulting from certain replacement services.

As would be expected, the network accessibility calculations show absolute increase in user benefits for all zones south of Massachusetts Avenue which are to the west of the existing alignment, and a variety of positive and negative impacts to those zones to the east of the existing alignment. Starting from the south and working north, the zones feeding to Forest Hills and Green Street stations (zones 100, 101, and south) have improved travel times to downtown, and greatly improved travel to Back Bay. Zone 103 show a similar benefit, attributable to walk-ons at Boylston Street station. (See Fig. IV-16).

All the zones which now feed by bus to Egleston station have neither demonstrably improved nor worsened service. Feeder bus time will increase by approximately three minutes: however, line time to downtown from Jackson Square will be 2.8 minutes faster than from Egleston. Those 15% of downtown riders destined for Back Bay and South Cove will save an average 10 minutes time with the new alignment. Thus, for those zones which feed to Egleston in the present system, there will be a small increase in total benefit, not shared by all riders. These zones can be described as essentially unchanged.

North of Egleston, the occurrence of disbenefit, (or increased transit times) is revealed in networks which do not contain explicitly designed replacement services. Comparisons of transit travel times to downtown Boston between the existing Orange Line and with the Southwest relocation indicate that south of Massachusetts Avenue five zones served by the existing line will have net increases in travel time if the Orange Line is relocated. These are zones 74, 106, 107, 109, and 112, which are served by Dudley, and Northampton stations. In 1980 an estimated 5,000 daily riders from these zones would use the Orange Line in the

"no build" option. This is more than one third of the total demand at the two stations. The downtown travel time increases suffered by the five zones would range from 1.7 to 6.3 minutes. An estimated 10 to 20 percent of the riders from these zones have destinations in the Back Bay area. For these trips the Relocated Orange Line would reduce total travel time by 0.3 to 2.0 minutes. The net disbenefit to riders from these four zones resulting from relocation of the Orange Line would be approximately $240,000 per year, of which 60 percent would be felt by zone 107 riders.

Within the South End, zones both to the east and west of the existing facility suffer accessibility loss when the Orange Line is relocated. In sum, zones north of Massachusetts Avenue will experience a net disbenefit of $286,000 per year of travel time differential. North of Massachusetts Avenue 20 travel zones served by the existing Orange Line would have increases in travel time to downtown Boston with the Southwest relocation of the Orange Line unless replacement service were provided. These are zones 38, 39, 40, 41, 43, 704, 705, 706, 707, 709, 710, 711, 712, 714, 716, 717, 718, 719, 721, and 722. (Traffic Zones within Boston Proper are considerably smaller than in the rest of the region.) The travel time increases would range from 0.5 to 7.2 minutes from these zones. With the "no build" option these zones would contribute approximately 25 percent of all Northampton boardings and 80 percent of all Dover boardings, or a total of 2,600 daily riders. (See Fig. IV-16A).

Travel time impacts from a network which has no service on Washington Street north of Dudley are somewhat artificial in and of themselves, for some form of surface transit would be established along that corridor. (The Authority's improvement of bus service along Main Street is Charlestown with the relocation of the elevated is an example of such a precedent here.) For this reason, service characteristics of two such possible services are presented below. However, it should be emphasized that the stated user benefit for the relocated Orange Line ($4.8 million per year in 1980) does <u>not</u> assume any replacement service.

4.3.1.5.4 Replacement Service

Two possibilities for a replacement service are a reserved right-of-way light rail line and a reserved lane bus line. A light rail line would run along Washington Street from Dudley station to Broadway on Broadway to Tremont, then into the Green Line subway through the abandoned trolley tunnel from Broadway to Boylston station, terminating at Park Street station. The reserved lane bus option route would run along Washington Street from Dudley Street to downtown and would terminate in the vicinity of State Street or Haymarket Square. By operating through the subway the light rail line time from any point to Park Street station would be about 0.7 minutes less than the busway time to Summer Street. However, the bus route would be more convenient for destinations on Washington Street in the downtown area.

The light rail line running time to Park Street would exceed Orange Line time to Washington Street by 4.8 minutes at Dudley, 3.2 minutes at Northampton and 0.9 minutes at Dover. However, the light rail line would have several additional stops. North of Massachusetts Avenue, the light rail or bus line would have stops in the vicinity of W. Concord Street, W. Brookline Street, Waltham Street, E. Berkeley Street, Broadway and the subway portal. This would reduce access time for riders now using Northampton and Dover stations by up to 5.8 minutes. Consequently

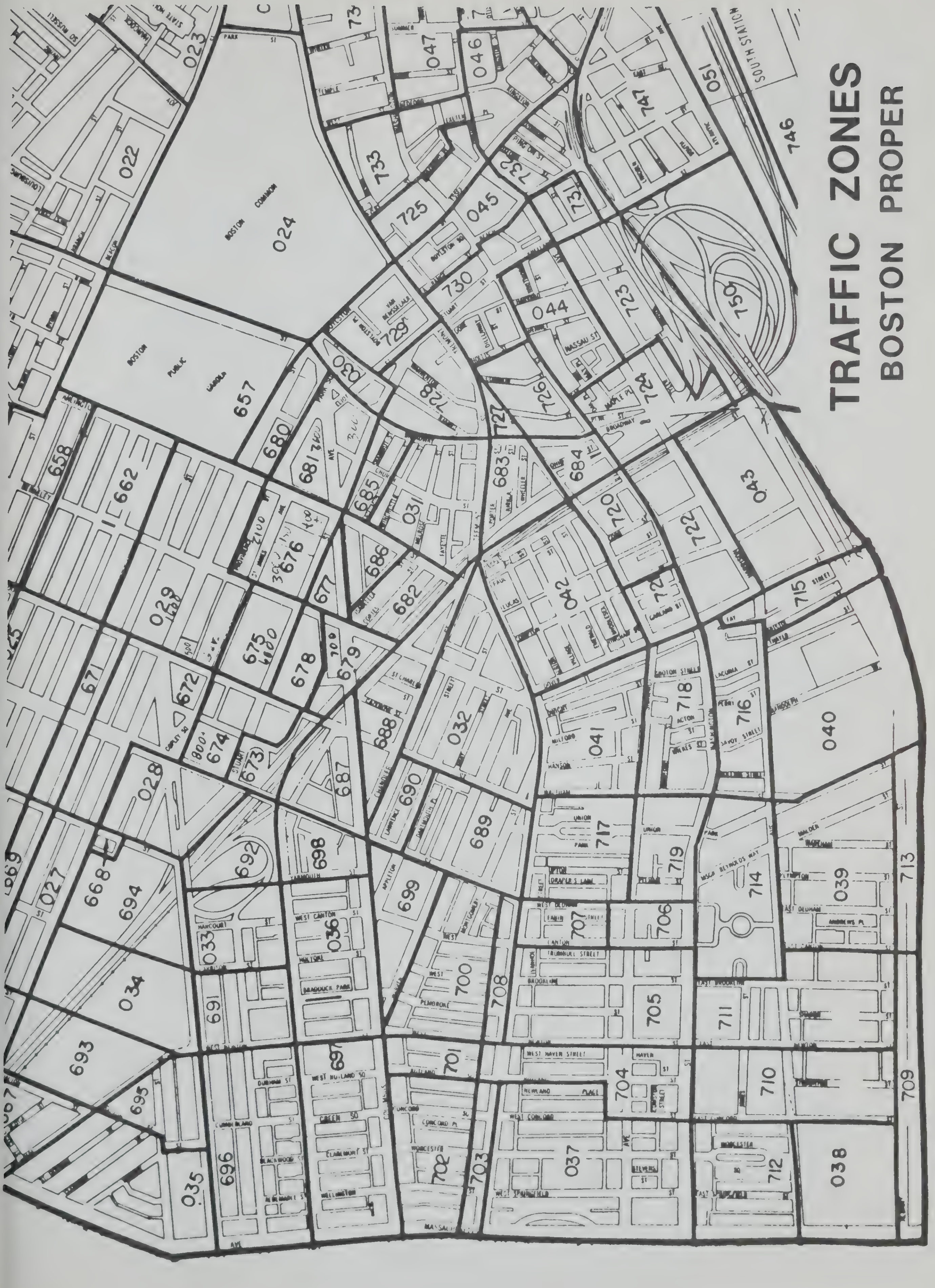


FIGURE IV–16A

if the replacement service were operated on the same headway as the existing Orange Line, travel times to downtown Boston would improve compared to existing service for 14 of the 20 zones that would otherwise have increases with the relocation. For the other six zones light rail replacement service would result in greater travel time than existing service.

A busway as replacement service would reduce downtown travel times compared with existing service for 12 of the 14 zones experiencing reductions with the light rail service. Transfer times would be greater from busway to other rapid transit lines than for a trolley.

The annual user benefit of light rail replacement service would be approximately $100,000 per year compared to the "no build" option, considering only benefits to users of the existing Orange Line from zones north of Massachusetts Avenue. Compared to the relocated alternative without replacement service the light rail replacement would have user benefits of $386,000 per year, again considering only benefits to users of the existing Orange Line from north of Massachusetts Avenue. The estimated operating cost for a light rail replacement from Dudley to North Station would be $1.6 million per year. An reserved bus lane replacement would have annual user benefits of $45,000 per year compared to "no build" and $331,000 per year compared to relocation withou replacement service. The annual operating cost for a bus service from Dudley to Haymarket Square would be $0.9 million per year.

South of Massachusetts Avenue the access time savings of a replacement service compared to the "no build" options would not be sufficient to offset the extra run time. The replacement service would, however, result in faster times to downtown from zones 109 and 112 than would the relocated service. The two zones contribute about 430 one-way daily riders to the existing Orange Line. The annual user benefit to these riders of a South End replacement service compared to a Relocated Orange Line alone would be $33,000 per year with the light rail option or $15,000 per year with the bus option.

Approximately 4,000 present Orange Line riders would use new surface transportation on Washington Street if it were provided.

In addition to these riders, the replacement service would attract some new ridership and would divert some riders from other transit lines such as the Tremont Street bus. A direct demand analysis for replacement service results in an estimate of 7,000 dialy riders. By way of comparison, in 1960, the last full year that streetcar service was operated from Lenox Street (near Northampton) to North Station via Tremont Street and the subway, there were 6,300 one-way daily riders. There have, of course, been significant population changes since that time.

Such an at grade facility through the South End would attract all of the walk-in riders in the Dudley Square area with downtown destinations, with service quality at least partially "replaced". What remains, however, in terms of geographic areas still experiencing disbenefit is the entire feeder area to the south and east of Dudley Square, particularly zone 107, which is bonded by Blue Hill Avenue and the Midlands Division right of way. To examine alternative methods of improving transit service to these areas, the Authority is undertaking a major "South End Replacement, Roxbury Replacement/Dorchester, Mattapan Transit Improvements Study". At the conclusion of this study, specific

proposals will be made for these areas. Because the data describing the user benefit of the relocated alignment assumes no such service, it represents the most conservative description of ultimate service conditions.

4.3.1.6 Orange Line Track Requirements

4.3.1.6.1 Analysis of Possible Express Track

A detailed analysis of the costs and benefits of providing an express track was conducted only for a relocated Orange Line extending to Route 128 in Needham. This alternative was determined to have less user benefit than a full local alternative. Fewer riders would use express service if the end of the Orange Line were at Forest Hills than if it extended to Route 128. Therefore, the user benefit of an express track would be even less with a Forest Hills terminal than with a Route 128 terminal. Although the current project is only for an Orange Line to Forest Hills, a decision on whether or not to ever provide an express track for rapid transit in this corridor must be made now in order to permit finalization of plans for upgrading of commuter rail and intercity rail service.

It would be expected intuitively that a service operated with an express track would have greater user benefit than a service operated with only local trains, but for the demand distribution expected in the Southwest Corridor this is not the case. If all trains ran local from Route 128 to downtown, the headway would have to be sufficiently short to provide space for all passengers boarding at stations up to and including Massachusetts Avenue, where peak load would be reached. In the express option neither the express nor the local trains would operate as frequently as trains in the all local case, so wait times would increase at all stations not served both by local and by express trains. During the peak period ,schedules on the entire Orange Line would be controlled by capacity requirements between Oak Grove and downtown Boston, because demand on that end of the line although lower over 24 hours has a higher peaking factor resulting in greater peak demand. During the maximum hour the headway with four car-trains would have to be 3 minutes for reasonable load factors. On the south this service could be in the form either of local service to Route 128 every 3 minutes, or of local service to Forest Hills every 6 minutes plus express service to Route 128 every six minutes. During the remaining two hours of the peak period headways would be 4 or 5 minutes combined, and 8 or 10 minutes on each branch.

Assuming that the express track were in service three hours each morning and three hours each evening in the peak direction five days a week, annual operating costs would be reduced by $0.4 million per year compared to a full local service based on the schedule described above. Passengers boarding at stations from Route 128 to Forest Hills inclusive would experience run time reductions valued at $1.2 million per year with express service compared to full local service. However, they would also experience perceived wait time increases of $0.8 million per year. The ramaining riders would experience no change in run times, but would experience perceived wait time increases valued at $0.6 million per year. Consequently provision of an express track would decrease overall user benefit of $0.2 million per year.

4.3.1.6.2 Conclusion - Orange Line Tracks

The construction of an additional Orange Line track in the project has been determined to be a somewhat marginal improvement to the transportation system. Because severe right-of-way constructions through the South End, the track could not continue north of Ruggles Street station. The travel time calculations reported in the above section assumed that the express trains would merge in with local trains at Massachusetts Avenue station. This assumption maximizes the possible running time advantage of the express train, and represents the 'best case' for the express track investment. However, the express trains would probably be operated only to Ruggles, where an extensive network of cross town bus connections and long-range circumferential transit are planned.

From a transportation standpoint, the most clear advantage of the express track would be its lower operating costs. In terms of user benefit, riders Forest Hills and south would experience improved line times, while the inner stations would suffer from longer headways. (Boarders on the inner stations would have more chance to get a seat in the express option, however.) The resulting aggregate used benefit is slightly negative, with the outer line time savings not outweighing the inner waiting time losses. Other operating assumptions could alter these calculations to some degree: however, the principal conclusion remains that the express service would provide only a marginal improvement in total corridor travel quality for a substantial increase in capital cost.

4.3.2 Railroad Track Requirements

4.3.2.1 Existing Conditions and Planning Assumptions

The existing Southwest Corridor track arrangement between Back Bay and Forest Hills consists of 4 railroad tracks used for intercity (AMTRAK) as well as for commuter rail services to Providence, Needham, Stoughton, and Franklin. Of these four the two center tracks are used almost exclusively for outbound* (track 1) and inbound (track 2) intercity and commuter rail trains. Track 4, easterly of tracks 1 and 2 is used for inbound commuter rail and local freight movements. Track 3, westerly of tracks 1 and 2 is used almost exclusively for inbound and outbound Needham commuter rail trains. The Needham branch diverts the main line right-of-way at Forest Hills.

The volume of traffic inbound in the morning peak during the heaviest hour which is between 8:00 a.m. and 9:00 a.m. is comprised of 9 inbound commuter trains arriving at South Station and 1 AMTRAK arrival. The corresponding outbound moves are comprised of 1 AMTRAK departure and 1 commuter train departure for Franklin. (See Fig. IV-17.)

The use of the present 4 track system has evolved overtime when traffic volumes were somewhat higher than today's volume. For example in 1906, between 8:00 a.m. and 9:00 a.m., 18 inbound trains were operated.

This section addresses the issue of the number of tracks needed in the Corridor to adequately handle not only existing traffic but future AMTRAK and commuter rail traffic, relative to relocating the Orange Line into the Southwest Corridor and sharing the same right-of-way. This issue must also be viewed in light of the potential use of the Midland Division through Dorchester which can provide an alternative rail route between Readville and South Station. What follows is a review and analysis of the present and future track needs of this system relative to various track configuration. The results of this analysis show that a

*Outbound means south (west) from Boston.

three-track system in the Corridor, along with one of the tracks of the Midland Division system would be needed to facilitate future combined high-speed and commuter-rail operations.

FIG. IV - 17

PRESENT 8 AM - 9 AM ARRIVAL SCHEDULE

Origin	Train #	Arr. into Back Bay AM	Headway if Operated over A Single Track	Double-track Headway Trk A	Double-track Headway Trk B
Needham	734	8:03			
			2 min.		
Providence	502	8:05			
			3 min.	5	
Franklin	712	8:08			6
			3 min.		
Stoughton	802	8:11		12	
			9 min.		
Amtrak	66	8:20			15
			6 min.		
Needham	736	8:26		10	
			4 min.		
Franklin	714	8:30			13
			9 min.		
Providence	504	8:39			
			7 min.	16	
Needham	738	8:46			14
			7 min.		
Stoughton	804	8:53			

At present there are 10 inbound arrivals into and 2 outbound departures from South Station in the heaviest traffic period between 8:00 a.m. and 9:00 a.m. If a two-track system is considered (one track exclusively for inbound movements and one track exclusively for outbound movements) and the existing schedule is used, the range of inbound headways would range between 2 and 9 minutes with an average of 5-1/2 minutes. If these trains were scheduled at uniform headways, that headway would be 6 minutes.

The feasibility of operating present trains for one hour at uniform headways of 6 minutes, is based on an estimated safe stopping time-distance of 3 minutes from 90 mph. This is also the time-distance needed to avoid being slowed by yellow block signals, based on existing signal spacing. On a 6-minute headway, these trains could not be more than 3 minutes late before they would beging to conflict with each other through the signal system.

Assumptions for future intercity service in additon to the commuter trains are determined by an agreement which was made between AMTRAK and the MBTA which allows room to operate up to 4 trains per hour per direction.

These assumptions proved to be a critical factor in the evaluation of track needs in the Southwest Corridor. On the pages that follow, analysis documents the possibility of running several different schedule assumptions over two-, three- and four-track segments. In each case, the need for high-speed trains to have one inbound track primarily reserved

for their operations emerges as the controlling variable in the analysis. If it were assumed that some AMTRAK trains could skip Back Bay station, and use the Midland Division, then the conclusions for the Southwest Corridor regarding rail requirements would be somewhat different. However, in this analysis, the continuation of service to Back Bay station (which AMTRAK views as a critical market area) has been assumed consistent with the provisions of the purchase and sale agreement for the Corridor right-of-way. This is consistent further with the joint understanding of the Commonwealth of Massachusetts and the Federal Railway Administration.

4.3.2.2 Creation of 1980 Schedules

In a process described in Appendix C two 1980 demand forecasts were made for the system. These forecasts were used to create train schedules which would supply adequate capacity consistent with the improved access time (improved headway) assumptions used in the forecasting process.

As a first step, present supply characteristics were examined to be used as a guideline in the creation of an "improved" 1980 commuter-rail schedule. Detailed ridership and train consist descriptions from 1974 revealed a per-vehicle occupancy factor of 79 passengers for both Budd RDC cars and standard coaches, between 7:30 and 9:00 a.m. at Back Bay. This represents an average load factor of 90 percent. Present average train length was calculated at somewhat above 5 cars (5.33).

The 30 percent and 40 percent increased ridership estimate can then be translated into train requirements by employing 1974 commuter-rail system operating characteristics to develop a description of the commuter-rail system needed to serve this estimated demand increase (see Fig. IV-18). By retaining the average 5-car train length and 79 passengers per car estimate, the following headways and train lengths could be utilized to carry 1980 volumes with general operating productivity characteristics similar to those of today:

FIG. IV-18

TRAIN LENGTH AND AVERAGE HEADWAYS IN MINUTES FOR DEMAND PROJECTED TO 1980

Line	1980 30% increase in demand: Peak Hour Train Length and Average Headway	1980 40% increase in demand: Peak Hour Train Length and Average Headway	1974 Consists arriving 8 a.m. to 9 a.m.
Needham	5,5,5,5 (15 min.)	5,5,5,6 (15 min.)	6,6,3 (20 min.)
Franklin	5,5,2 (20 min.)	5,5,3 (20 min.)	8,2 (30 min.)
Stoughton	5,5 (30 min.)	5,6 (30 min.)	6,2 (30 min.)
Providence	5,5,5,5 (15 min.)	5,5,6,6 (15 min.)	10,5 (30 min.)
Total # of CRR Trains	13	13	9
AMTRAK	4	4	1
TOTAL	17	17	10

4.3.2.3 Creation of 1990 or "Maximum Case" Schedules

For the 1990 case, desirable supply characteristics were established jointly by CTPS and the MBTA Commuter Rail Directorate. Service levels agreed upon called for service every fifteen minutes in the peak hour on each of the branches presently served. Additional service was agreed upon every fifteen minutes from station 128. Demand patterns revealed in the 1980 data were manually extrapolated to 1990. It was concluded that the basic pattern of five-car trains was consistent with the long-term demand in most operations. However, precise demand forecasts were not made to compute the actual length of each train in the schedule proposed. Headways were found to be reasonably consistent with both present train length, and service levels desired for 1990 and beyond. As in the previous step, positions were "reserved" for four AMTRAK trains per hour. Schedules were created with and without an improved Needham commuter rail service.

The 1990 schedules define 24 inbound trains per hour as the "maximum" rail utilization option. No explicit effort has been undertaken to forecast the exact headway needs of each branch. For example, in the maximum rail case, Needham commuter-rail service might be operated with six trains per hour, rather than four AMTRAK with two rather than four tracks. The figure of 24 trains per hour, therefore, should be considered as the basic description of the 1990 maximum rail condition, rather than the exact allocation of trains among branch services planned at this point.

As a result, 1990 and beyond schedules were established as follows:

	Peak Hour Arrivals at Back Bay	
Needham	4	(15 minutes headway)
Franklin	4	
Stoughton	4	
Providence	4	
128	4	
AMTRAK (given)	4	
	24	

This schedule, (with train lengths unspecified) was established as a reasonable maximum service schedule for long-term corridor planning. Branch service is provided on quarter hour headways, while the combined Main-Line service through the 128 Park-Ride facility would be as low as 5 minutes, on average. The schedule represents a reasonable maximum.

4.3.2.4 Examination of Alternatives

Each of the alternative track options was examined in terms of theoretical capacity, and in terms of probability of schedule reliability. Each option was so examined in the time frame of 1980 and 1990, both with and without Needham CRR service assumed. Primary attention was paid to the issues surrounding the combined operation of high-speed inter-city railroad service with standard commuter rail equipment.

The decision to propose three railroad tracks between Forest Hills and Back Bay with an additional railroad track on the Midland Division was made jointly by the MBTA, EOTC, AMTRAK, and the Federal Railroad Administration after an extensive analysis of known and projected requirements in the corridor. The FRA has undertaken detailed supply simulations which document the track requirement of inter-city services, and the potential for shared operations with local service. The MBTA

Commuter Rail Directorate has also performed analyses of regional rail requirements, and compatibility with high-speed rail services. This section of the Environmental Impact Analysis presents a greatly summarized description of the salient conclusions of those studies.

The three-track option has been examined in the context of all the schedules prepared for th 1980 and 1990 timeframes, with and without CRR service to Needham.

4.3.2.5 Three Tracks, Compared with Two Track Option

1980 - without Needham. From the point of view of theoretical capacity, three tracks would not be required to handle the CTPS 1980 railroad schedule. Allowing 6 minutes headway for each of the agreed-upon AMTRAK four-trains-per-hour, the nine CRR trains would operate on a average 4-minute headway. Given that the present signal system gives a full green after a 3.3-minute block, the four-minute headway is within the theoretical range of capacity. (If only two AMTRAK trains were operated, the nine CRR trains would operate at approximately 5-minute headways.)

From a reliability standpoint, the intermixing of long-distance service with CRR frequencies of 4 minutes raises serious facility management questions. The maintenance of the 4-minute headway would require considerable effort, given the number of variables affecting railroad reliability, (e.g. station dwell) times, grade-crossing management). The differential between the signal timing and the headway provides only minimal opportunity for "correcting" a schedule which has become out of phase. If a train were over 40 seconds late, the first following train would be affected. If the first train were 80 seconds late, the scheduled performance of the first and second following trains would be affected. There would be a potential ripple effect throughout the peak hour service. These rough calculations serve to demonstrate the nature of service reliability under close headway conditions for the CRR trains themselves.

Maintenance of the schedule discussed here is made considerably more difficult when there is joint operation with long distance rail over a single inbound track. Operation of the majority of the service on headways with less than one minute as a recovery factor, is largely incompatible with inter-city rail services.

Three tracks are required to give the flexibility needed in scheduling the inter-city and the commuter rail system with the associated speed differentials.

In short, the minimum service schedule analyzed in this Environmental assessment, (consistent with stated constraints concerning agreed-upon AMTRAK service) could be operated over a two-track SW project segment, but with a considerably increased factor of unreliability over present operations. Even with the minimum schedule analyzed, a three-track right-of-way would be highly desirable in order to separate inter-city trains from commuter operation.

1980 - with Needham. One inbound track would be inadequate to carry 13 CRR trains per peak hour, plus the agreed-upon four AMTRAK trains. Assuming, again, a 6-minute block for the AMTRAK service, CRR operations would average under 2.8 minutes headway. This is not consistent with present technology assumptions. A three-track facility would be required by the CTPS 1980 CRR schedule which includes Needham.

1990 Schedules. The two-track option would be insufficient for the requirements of the "maximum" 1990 CRR schedule, with or without Needham CRR service.

4.3.2.6 Three Tracks Compared with the Four-Track Option

1980 - without Needham. The three-track option would be sufficient to operate the CTPS 1980 CRR schedule without Needham, from the viewpoint of both theoretical capacity and margin of error for reliability. If the AMTRAK inbound services were operated on an exclusive track, the nine CRR trains in this scenario would have average headways of over 6.5 minutes which incorporates a generous recovery factor of over 3 minutes in each interval. In the event of breakdown in either direction, the third track could be used to by-pass disabled equipment.

1980 - with Needham. A three-track facility would be sufficient for the CTPS 1980 CRR schedule including Needham service. Assuming that four of the 13 CRR trains shared the high-speed track with the inter-city service, no trains on the corridor would need to have closer than a 6.5-minute interval.

Again, under emergency conditions, trains could be re-routed to the third track to avoid breakdowns, or other unforeseen situations.

1990 - without Needham. In this planning scenario, the three-track section of the proposed Southwest project would be sufficient to handle the 16 CRR trains in addition to the four AMTRAK trains. The proposed three-track section between Forest Hills and Back Bay and South Station would accommodate the CTPS 1990 CRR schedule "without Needham" with considerable room for flexibility of operation. Additional tracks would be desirable between Readville and 128 in both 1990 options. As is similar to the above case, the average headway would not need to go below 6 min. on either track between Forest Hills and Back Bay.

1990 - with Needham. In the "maximum" rail option a total of 24 trains would operate inbound during the 1990 peak hour. If eight Main Line CRR trains shared the high-speed track, 5-minute headways would exist on that track. The remaining 12 inbound trains would utilize a common track at an average 5-minute headway.

The MBTA Commuter Rail Directorate has undertaken an extensive examination of the adequacy of the three-track proposal for a 1990 maximum schedule. This analysis shows that in the peak period there would be twelve outbound movements through the corridor, in addition to the twelve inbound movements per track assumed in the maximum schedule. The maximum schedule, therefore, could be accommodate with average headways of 5 minutes throughout the project.

4.3.2.7 Conclusion - Three Railroad Tracks

The examination of the ability of the proposed three-track project to accommodate each of the schedule scenarios has shown that the three-track option is highly desirable in the most moderate of the forecasts, and fully adequate in the most optimistic of them. Even in the 1980 "without Needham" schedule, the enforced mixing of commuter rail operations with intercity operations that would be caused by the two-track (one in-bound) option would result in an inflexible and unreliable service. The provision of the separate track, allows additional facilities management options which are desirable in any circumstance.

Extensive negotiations between the Commonwealth and the Federal Railway Administration have resulted in an agreement that the provision of three railroad tracks between Forest Hills and South Station is an essential element in the Southwest Corridor project. This option has been found to be adequate to accommodate all foreseen growth in both metropolitan and inter-city demand for services.

4.3.3 Arterial Street Concepts

The concept identified for arterial street improvements in the Southwest Corridor is to make effective use of the land previously acquired for highway purposes for Interstate 95. This would limit the location of any arterial street development to a specific area extending from the intersection of Columbus Avenue at the new crosstown arterial to Forest Hills parallel to the railroad right-of-way to Forest Hills.

Many different arterial street configurations would be possible within this area. The specific design and location details would vary according to the rail/transit options. Section 4.4 offers a more detailed description of the specific alternatives evaluated in this analysis.

4.4 Description of Project Alternatives

A wide variety of alternatives (as well as options within alternatives) were investigated during the study process. Of the alternatives discussed here, the rail/transit facilities and the Arterial Street have a particular set of options within each section of each project area.

The rail/transit options studied between Camden Street and Forest Hills, for example, deal with the depression or modification (higher and wider) of the existing Penn Central embankment. The Arterial Street options are concerned with being East or West of the rail facilities in this area, south of Jackson Square. Additionally, the possibilities of not building either or both facilities exists as well as building portions of the Arterial.

Between South Cove and Camden Street, two alternatives are presented. One would be several feet below existing grade for the combined rail/transit facility. The other studies an Orange Line tunnel to the vicinity of Dartmouth Street. The Arterial Street is not a part of the project in this area.

The facility studies for rail/transit, stations and the Arterial Street were made so that, where feasible, various compatible elements could be combined. Fig. IV-19 shows that a large number of combinations are possible.

In order to simplify understanding of the project alternatives, alternatives which exist within each of two boundaries are described. The two boundaries are: South Cove to Camden Street and Camden Street to Forest Hills.

All other alternatives studies are described in Section 4.5 with references to Appendix F.

The details, dimensions, and facility configurations described in Sections 4 and 5 represent reasonable design concepts attainable in this project. Final design will reflect later information resulting from in-depth studies and may dictate details, dimensions and facility configurations other than those described.

4.4.1 Alternative N.B. 1 South Cove to Forest Hills No-Build Rail Transit, No-Build Arterial Street

4.4.1.1 Existing Orange Line

The existing Orange Line from Haymarket Square station to Forest Hills station is 5.8 miles long consisting of 1.1 mile of tunnel and 4.7 miles of elevated structure. There are 10 stations within the length, four in the tunnel and six on the elevated sections.

Under the No-Build Alternative, the following would result:

- The Orange Line will remain on the elevated structure.
- Only normal maintenance would be performed.
- No platform lengthening would be constructed, thereby restricting the system to four 65-foot car trains.
- Dudley Station track work modifications would be completed to accommodate 65-foot cars.

4.4.1.2 South Cove Project

The completed section of the South Cove project consists of a two-track tunnel section, fifteen hundred feet long, extending from a point approximately one hundred feet north of Kneeland Street to the intersection of Marginal Road and Shawmut Avenue.

Under the No-Build Alternative the following would result:

- The transit facility would be constructed and operated to South Cove station and to a station just east of existing Back Bay Station.
- Back Bay railroad station would remain unchanged.

4.4.1.3 Amtrak

The Amtrak system now uses the Penn Central trackage for inter-city service and has entered into an agreement with the Commonwealth to allow particular levels of future service. No-build alternatives considered, therefore, would not prevent Amtrak related improvements from being undertaken.

4.4.1.4 Commuter Rail

Commuter rail presently uses the Penn Central trackage for local commuter service.

Under the no-build alternative, commuter rail upgrading would proceed as defined by the MBTA's continuing commuter rail improvements program (CRIP).

4.4.1.5 Arterial Street

A no-build alternative for the Arterial Street would mean that only normal maintenance of the existing streets would take place. The selection of the no-build alternative, however, will not rule out improvements to the existing local street system which would normally qualify as " on Major Federal Actions" under FHPM 7-7-2. Arterial Segment #1, described in Section 1.2.3, would fall into this category and would provide for cross-town movements and allow the closing of certain existing local streets between Columbus Avenue - Tremont Street and the Southeast Expressway at Massachusetts Avenue.

4.4.2 Alternative SC-1, South Cove to Camden Street - With Minimum Grade Adjustments to all Tracks

Alternative SC-1 consists of a rail/transit facility extending from the portal of the proposed South Cove tunnel in the vicinity of Arlington Street to Camden Street a distance of 1 mile. (See Fig. IV-63 to IV-65).

Throughout the length of this portion of the project the rail/transit facility will be either in a depressed section or at grade allowing a minimum of 17'-8" overhead railroad clearance (IV-69). No bridges or viaducts are anticipated to carry the transit or railroad. The existing station site at Back Bay will be utilized and a new site will be used for a station at Massachusetts Avenue.

The proposed relocated Orange Line will pass through area largely residential in nature which spans from Back Bay station to Northeastern University. A short section of business oriented property is located between Columbus Avenue and Back Bay Station on the northerly side of the Massachusetts Turnpike.

The proposed alternative would connect with the Orange Line facilities planned for the South Cove area and would not require any alignment changes to that project. As part of the South Cove Tunnel Extension Project, the existing tunnel would be extended from its present terminal point in the vicinity of Shawmut Avenue and Oak Street under Marginal Road in South Cove, under the Massachusetts Turnpike, under two Boston and Albany tracks, under the Tremont-Street -Arlington-Street Bridge ascending to a location approximately 350 feet west of Arlington Street. The tunnel would surface between the two existing Boston and Albany tracks and the three new Penn Central Shore Line tracks located parallel to the Massachusetts Turnpike .

(FIG. IV-19)

Combined Alternatives	Alternative Boundaries & Designation: South Cove to Camden St.	Camden Street to Forest Hills
• NO BUILD RAIL/TRANSIT, NO BUILD ARTERIAL STREET	NB-1	NB-1
• DEPRESSED RAIL/TRANSIT, NO ARTERIAL STREET	-	FH-1
- with minimum grade adjustments, all tracks	SC-1	-
- with Orange Line in tunnel to Dartmouth Street	SC-2	-
- with Forest Hills Station elevated (option)	-	FH-1a
• DEPRESSED RAIL/TRANSIT, ARTERIAL STREET EAST	-	FH-2
- with minimum grade adjustments, all tracks	SC-1	-
- with Orange Line in tunnel to Dartmouth Street	SC-2	-
- with Forest Hills Station elevated (option)	-	FH-2a
- with Arterial to Jackson Square only (2 options)	-	FH-2b, 2c
• RAIL/TRANSIT ON MODIFIED EMBANKMENT, NO ARTERIAL STREET	-	FH-3
- with minimum grade adjustments for all tracks	SC-1	-
- with Orange Line in tunnel to Dartmouth Street	SC-2	-
• RAIL/TRANSIT ON MODIFIED EMBANKMENT, ARTERIAL CROSSING EAST TO WEST	-	FH-4
- with minimum grade adjustments, all tracks	SC-1	-
- with Orange Line in tunnel to Dartmouth Street	SC-2	-
- with Arterial to Jackson Square only (2 options)	-	FH-4a, 4b
• MODIFIED-DEPRESSED RAIL/TRANSIT, ARTERIAL STREET EAST	-	FH-5
- with minimum grade adjustments, all tracks	SC-1	-
- with Orange Line in tunnel to Dartmouth Street	SC-2	-
• MODIFIED-DEPPRESED RAIL/TRANSIT, NO ARTERIAL SOUTH OF JACKSON SQUARE	-	FH-6, 6a
- with minimum grade adjustments, all tracks	SC-1	-
- with Orange Line in tunnel to Dartmouth Street	SC-2	-

East of the proposed portal the Boston and Albany and the Penn Central tracks diverge in order to provide sufficient width to accommodate seven tracks at the tunnel portal.

The Boston and Albany tracks west of the portal would be rebuilt in approximately their original location. The new trackage would merge with the existing track at Dartmouth Street.

4.4.2.1 Back Bay Station Area (Fig. IV-64)

At Back Bay station, the two proposed Orange Line tracks and three shared Amtrak and Commuter Rail (Railroad) tracks would be aligned so as to allow for a center platform rapid transit. The Railroad facility would be provided with both side and center platforms.

Upgrading of the Boston and Albany line (B&A) to provide high platforms is not under consideration, but allowances have been made in the station layout for future upgrading.

Overall station dimensions utilized provide for 410 feet long Orange Line platforms of variable width (18 to 23'), on 1° curvature (R = 5730'), (center and side), each 1200 feet long. The center platform would vary in length from 24 to 16 feet. The side platform would have a minimum width of 12 feet. Maximum horizontal track curvature for both the side and center platform would be 1/2° (R = 11,460').

The combined width of 7 tracks and platforms in the Back Bay area require the rebuilding of Back Bay Station, rebuilding of 3 bridges; the demolition of 8 buildings in the South End, underpinning of the 6-story, reinforced concrete Heath building at 285 Columbus Avenue; the removal and reconstruction of approximately 2000 feet of granite wall and the reconstruction of Buckingham Street.

4.4.2.2 South of Back Bay Station

The rapid transit and rail tracks would be aligned within the existing Penn Central right-of-way south and west of Back Bay Station. The cross-sectional width required in this area is 70 feet as illustrated in Fig. IV-69. The horizontal alignment is on a tangent section between Yarmouth Street and Ruggles Street. In Yarmouth Street area the tracks are approximately 5 feet below the grade of the surrounding terrain while the grade of the tracks is 0.0 percent. Five tracks would be located in the rail/transit corridor from Back Bay Station to Forest Hills Station.

Structures in the section between Back Bay Station and the proposed Massachusetts Avenue Station include a vehicle bridge at Dartmouth Street a foot bridge at Follen Street/Braddock Park, a vehicle bridge at West Newton Street, a foot bridge at Durham Street/West Rutland Square and a vehicle bridge at Massachusetts Avenue which would be replaced. The proposed Massachusetts Avenue Station would be located adjacent to and west of Massachusetts Avenue with access at both Massachusetts Avenue and Gainsborough Street. The tracks at the Massachusetts Avenue area would be 2 feet below the surrounding area. The grade on the tracks through this section would be 0.0 percent to accommodate the station platform. The foot bridge located at Gainsborough Street/Camden Street would be rebuilt as part of the Massachusett Avenue Station.

There would be five tracks at Massachusetts Avenue Station, three railroad and two transit. The railroad tracks would be on tangent alignment and located on the easterly side of the corridor. The inbound transit track would be on tangent alignment and the outbound transit track would be constructed on an alignment consisting of two reversed curves and a tangent section designed to accommodate the 410 foot platform.

Structures to be constructed under the SC-1 Alternative include:

Berkeley Street
Columbus Avenue/Clarendon Street
Buckingham Street
Dartmouth Street
Follen Street (footbridge)
West Newton Street
Durham Street (footbridge)
Massachusetts Avenue
Camden Street (footbridge)
Bay Bay Station

Alternative SC-1 requires the demolition of eight buildings, Back Bay Station and one shed. Additionally a multi-story building would require underpinning.

4.4.3 Alternative SC-2, South Cove to Camden Street with Orange Line in Tunnel to Dartmouth Street (See Fig. IV-66, IV-67 and IV-68)

Alternative SC-2 consists of a cut-and-cover tunnel extending from the terminus of the South Cove tunnel to Dartmouth Street and a combination semi-depressed and at-grade facility from Dartmouth Street to Camden Street.

Throughout this section the existing tracks would be adjusted to provide for 17'-8" vertical clearance. No bridges or viaducts are anticipated to carry the transit or the railroad. The existing site of Back Bay Station would be utilized for the proposed new Back Bay Station while the proposed Massachusetts Avenue Station would be on new site located between Massachusetts Avenue and Camden Street.

The proposed relocated Orange Line would pass through a primarily residential area which extends from Back Bay to Northeastern University. A short section of business-oriented property is located between Columbus Avenue and Back Bay Station on the northerly side of the Massachusetts Turnpike.

This alternative would connect with the Orange Line facilities planned for the South Cove area and would not require any alignment changes to that project. As part of the South Cove Tunnel Extension Project, the existing tunnel would be extended from its present terminal point in the vicinity of Shawmut Avenue and Oak Street under Marginal Road in South Cove, under the Massachusetts Turnpike, under two Boston and Albany tracks, under the Tremont-Street-Arlington-Street Bridge to a point approximately 100 feet west of Arlington Street. Under alternative SC-2, the transit facility would be carried in a twin-box cut-and-cover tunnel from that point, along the Penn Central right-of-way on a tangent alignment approaching the Bay Back Station area. The tracks in this section would be on an ascending 0.5% grade and would be approximately 21 feet below the grade of the existing railroad tracks. (See Fig. IV-68).

4.4.3.1 Back Bay Station Area (Fig. IV-67)

At Back Bay Station the transit-tunnel alignment would be on a 14.3° (R = 400') curve to the left approaching the station-platform area which would be on tangent. The transit platforms would be located one level below the Amtrak and commuter-rail platform which would be one level below existing streets. A system of escalators and elevators would be utilized to transfer patrons from one level to another. The transit station would have two 410 foot side platforms.

The Boston & Albany Railroad platform would be center loaded, varying in width from 24 feet to 12 feet. The two Amtrack and commuter platforms wold be 1200 feet long and serve three tracks.

The transit facility would be on an ascending 0.5 percent grade through the Back Bay Station area and the railroad grades through the station area would be 0.5 percent.

4.4.3.2 South of Back Bay Station (Fig. IV-66 and IV-67)

South of Back Bay Station the transit facility, still in a cut-and-cover section, curves left on a 143° (R=400') curve and is aligned with the existing rail on the westerly side of the existing tracks. The transit tunnel portal would be located 175 feet south of Dartmouth Street. The tracks would be in a semi-depressed section from the portal to a point 1300 feet south, constructed on a 0.0 percent grade. Beyond the semi-depressed section, the transit and rail tracks would be constructed on a 0.5 percent grade, essentially at-grade into the proposed Massachusetts Avenue Station.

The proposed Massachusetts Avenue Station would be located adjacent to and south of Massachusetts Avenue with access at both Massachusetts Avenue and Gainsborough Street/Camden Street. The tracks at the Massachusetts Street area would be 2-5 feet below the surrounding area. The grade on the tracks through this section would be 0.0 percent. The foot bridge located at Gainsborough Street/Camden Street would be rebuilt as part of the Massachusetts Avenue Station.

There would be five tracks at this location, three railroad and two transit. The three railroad tracks would be on tangent alignment through the station area with no platforms provided. A center platform would be provided for the two transit tracks. The inbound track would be on tangent alignment in this area and the outbound track alignment consisting of a reverse curve, short tangent and a reverse curve to accomodate the proposed 410 foot platform.

Structures to be re-built under the SC-2 Alternative include:

Berkeley Street
Columbus Avenue/Clarendon Street
Buckingham Street
Dartmouth Street
Follen Street (footbridge)
West Newton Street
Durham Street (footbridge)
Massachusetts Avenue
Camden Street (footbridge)
Back Bay Station

This alternative would require the demolition of two buildings and Back Bay Station.

4.4.4 Alternative FH-1, Camden Street to Forest Hills - Depressed Rail/Transit - No Arterial Street (Figures IV-20 thru IV-26)

Beyond Northeastern University the area is predominately residential with the exception of two areas of industrial development; one, west of the tracks between Prentiss Street and Heath Street and the second on the east side of the track between Williams Street and Forest Hills. From Walpole Street to Forest Hills, the land abutting the Penn Central right-of-way is, to a varied degree, cleared. Much of the land was cleared for the proposed, but now abandoned I-95 South.

The alignment of the rail/transit facility for the section between Camden Street and Ruggles Street would be on a tangent section which would follow the existing Penn Central alignment (see Fig. IV-25 and IV-26). The proposed profile for that section would, after an initial 1 percent grade, consist of a series of flat grades which would maintain a relatively constant depth of section approximately 20 feet below the grade of the existing terrain. The typical depressed sections for this area are shown on Fig. IV-62. Ruggles Street Station, as proposed, would be located north of Ruggles Street.

South of the proposed Ruggles Street Station, the rail/transit facility would be continued on a tangent section to Station Street where it curves left on a 1.4° (R= 4000') curve to New Heath Street where a 700 foot tangent section begins. The tangent section continues to Relocated Heath Street where a 1.4° (R=4000') curve to the right begins and continues through Jackson Square. The rail/transit facility in this section would be completely within the existing right-of-way (see Fig. IV-24, IV-25 and IV-26).

In the section between the proposed Ruggles Street Station and Jackson Square the rail/transit facility would remain in a depressed section utilizing a relatively flat-grade profile to maintain a uniform section approximately 20 feet below the surrounding existing ground. Within this section, the impact of the depressed section would affect the local streets which presently pass under the railroad. Under this alternative local streets would cross above the tracks. The local streets affected by this alternative would be Ruggles Street, Prentiss Street, Station Street, Tremont Street, New Heath Street and Heath Street. Fig. IV-62 illustrates the location of rail/transit facility relative to the surrounding terrain.

Roxbury Crossing Station would be located at Tremont Street and Jackson Square Station would be located between Heath Street and Centre Street.

Jackson Square to Forest Hills, a distance of 1.8 miles will be the final section of the proposed Orange Line relocation although certain station studies indicate additional work would be required south of Forest Hills to transition the new railroad track grades back to existing.

South of Jackson Square, the horizontal alignment continues on a 1° (R=5730') curve to the right to the vicinity of Ray Street where a tangent section begins and extends to Hoffman Street. The alignment then curves left on a 1° (R=5730') curve through the Boylston Street Station area to a point a few hundred feet south of Hubbard Street. A 600-foot tangent section extends to Minton Street where the alignment follows a 1° (R=5730') curve to the right to Gordon Street. South of Gordon Street the alignment would be on tangent to William Street where a 1° (R=5730') curve to the left extends to McBride Street. From McBride Street to the Forest Hills Station area the horizontal alignment would be in a tangent section (see Fig. IV-20, IV-21 and IV-23). The rail/transit facility in this area is in a depressed section approximately 20 feet below the grade of the surrounding terrain (see Fig. IV-62). The profile in this location would have maximum grades of 0.6 percent with 0.0 percent grades at the proposed station location.

The proposed stations in this section are Jackson Sqaure Station located between Heath Street and Centre Street, Boylston Street Station located at Boylston Street, Green Street Station located at Green Street and Forest Hills Station located south of Morton Street.

Streets to be bridged over the transit/rail facility in this section include Mozart Street, Paul Gore Street, Boylston Street Minton Street, Green Street, Williams Street, McBride Street and Morton Street.

Construction on local streets under this alternative will be limited to the areas around the proposed stations and any work necessitated by the replacement of railroad bridges over local streets.

The Arterial Street was broken into three segments:

> Segment one: That part of the Arterial Street route from the Southeast Expressway ramps at Massachusetts Avenue to Ruggles Street. The proposal which is being advanced as a non-major action project, calls for a four-lane facility following the general alignment of the corridor cleared for the abandoned Boston Inner Belt.
>
> Segment two: From the end of segment one at Ruggles Street along the easterly side of the Penn Central tracks to Jackson Square.
>
> Segment three: From the end of segment two at Jackson Square along the easterly side of the Penn Central tracks to Mozart Street. From Mozart Street there is an option to either continue the Arterial Street on the easterly side of the track to Forest Hills or to cross over the tracks and locate the Arterial Street on the westerly side of the tracks and terminate at Forest Hills.

Segment one as noted previously has been declared a Non-Major Action and will be designed and constructed as proposed. Segment two is not essential to the feasibility of Segment one which is capable of standing alone as a complete project.

The corridor defined as Segment two, Ruggles Street to Jackson Square, has an existing Arterial Street system consisting of Columbus Avenue and Tremont Street one block apart at Ruggles Street and converging at Roxbury Crossing with Columbus Avenue continuing on to Jackson Square. Segment two is approximately one mile in length.

The Arterial Street proposed for Segment two is a six-lane arterial beginneng at Ruggles Street located parallel to and east of the Penn Central alignment (see Fig. IV-31 thru IV-33). The Arterial Street will closely follow the Penn Central alignment which in this area is almost totally on a 1.4° (R=4000') curve.

The roadway cross section for Segment two could consist of a sidewalk with a planting strip, a parking lane, three travel lanes in each direction divided by a median. Variation in the median width at intersections for the purpose of accommodating left turns are possible. The location of the left turn storage lanes would be determined in the design phase. At the back of sidewalk, provisions would be made for continuous open space and green belt landscaping where feasible (see Fig. IV-61). A pedestrian drop area or kiss-and-ride slot would be provided for the Arterial Street at Roxbury Crossing Station. The major intersections, Ruggles Street, Tremont Street, Heath Street and Centre Street would be signalized.

Segment two of the proposed arterial street can be designed and constructed to function properly without Segment three (see Fig. IV-31A).

Jackson Square to Forest Hills, a distance of 1.8 miles would be the final section of the proposed Orange Line Relocation although certain station studies indicate additional work will be required to be done south of Forest Hills to allow a transition of the new railroad track grades back to existing.

The station proposed for Forest Hills under the depressed rail/transit alternatives (FH-1 and FH-2) would be designed with the tracks located at an elevation 30 feet below the level of the tracks as they presently exist. The grade of the tracks from the north through the station would be 0.5 percent ascending south followed by a 1 percent grade also ascending south. The concept of having the rail/transit tracks in a depressed section through the station area would necessitate extending the railroad tracks approximately 3000 feet south before the existing grade could be met.

4.4.5 Alternative FH-2 Camden Street to Forest Hills - Depressed Rail/Transit Arterial Street East (Figures IV-27 thru IV-33)

4.4.5.1 Alternative FH-2 is essentially the same as FH-1 with the addition of the arterial street. The section between Camden Street and Ruggles Street is on a tangent alignment completely within the existing Penn Central right-of-way. The proposed profile for the section between the Massachusetts Avenue Station and the Ruggles Street Station will, after an initial 1 percent, consist of a series of flat grades which will maintain a relatively constant depth of section (see Fig. IV-32 and IV-33). A typical depressed section for this area is shown on Fig. IV-62. Ruggles Street Station as proposed will be lcoated north of Ruggles Street.

South of the proposed Ruggles Street Station the rail/transit facility would be constructed on a tangent section to Station Street where it curves left on a 1.4° (R=4000') curve to New Heath Street where a 700-foot tangent section begins. The tangent section continues to Relocated Heath Street where a 1.4° (R=4000') curve to the right begins and continues through Jackson Square. The rail/transit facility in this section would be completely within the existing right-of-way. The facility would remain in a depressed section utilizing a relatively flat-grade profile to maintain a uniform section. In this section, Ruggles Street to Jackson Square, the impact of the depressed section would affect the local streets which presently pass under the railroad, but under this alternative would cross above the tracks. The local streets affected by this alternative would be Ruggles Street, Prentiss Street, Station Street, Tremont Street, New Heath Street and Heath Street. Roxbury Crossing Station would be located at Tremont Street and Jackson Square Station would be located between Heath Street and Centre Street (see Fig. IV-31, IV-32 and IV-33).

4.4.5.2 An arterial street system was developed in conjunction with the Orange Line Relocation as part of the Southwest Corridor Study. The arterial street system was developed for the purpose of eliminating through traffic from the local residential streets in the area and to provide better traffic circulation in the proposed station areas. The route of the proposed arterial street would essentially follow the route cleared for the abandoned I-95 South (see Fig. I-3).

The route is generally defined as: beginning at Massachusetts Avenue parallel and south of Albany Street, curving westerly crossing Albany Street at Green Shoe Co., crossing Harrison Avenue at Webber Street, crossing Washington Street, Shawmut Avenue, Westminster Street and Warwick Street adjacent to Sterling Street. From this location the proposed Arterial Street alignment curves southerly across Tremont Street at Weston Street and is generally aligned with the Penn Central tracks at Ruggles Street. From Ruggles Street to Jackson Square the Arterial Street is parallel and adjacent to the easterly side of the Penn Central tracks. South of Jackson Square the alignment is still parallel and adjacent to the Penn Central tracks but with the option of being east or west of the tracks and terminating at Forest Hills.

4.4.5.3 South of Jackson Square the horizontal alignment continues on a 1.4° (R=4000') curve to the right to the vicinity of Roy Street where a tangent section begins and extends to Hoffman Street. The alignment then curves left on a 1° (R=5730') curve through the Boylston Street Station area to a point a few hundred feet south of Hubbard Street. A 900-foot tangent section extends to Minton Street where the alignment follows a 1° (R=5730') curve to the right to Gordon Street. South of Gordon Street the alignment would be on tangent to William Street where a 1° (R=5730') curve to the left extends to McBride Street. From McBride Street to the Forest Hills Station area the horizontal alignment would be in a tangent section (see Fig. IV-27, IV-28 and IV-30). The rail/transit facility in this area is in a depressed section approximately 25 feet below the grade of the surrounding terrain (see Fig. IV-62). The profile in this location will have maximum grades of 1 percent with 0.5 percent grades at the proposed station location.

The proposed stations in this section are Jackson Square Station located between Heath Street and Centre Street, Boylston Street Station located at Boylston Street, Green Street Station located at Green Street and Forest Hills Station located south of Morton Street.

Streets to be bridged over the transit/rail facility in this section include Mozart Street, Paul Gore Street, Boylston Street, Minton Street, Green Street, Gordon Street, Williams Street, McBride Street and Morton Street. A pedestrian bridge will be constructed at Cornwall Street.

4.4.5.4 An Arterial Street, Segment three, was developed in conjunction with the Jackson Square to Forest Hills section of the rail/transit facility. Beginning at Jackson Square, the southerly limit of Segment two, the Arterial Street, if extended, transitions from a six-lane divided roadway to a four-lane undivided roadway. The horizontal alignment closely follows the rail alignment on the easterly side of the tracks. At the southerly end of Segment three, the Arterial Street transitions into the local street pattern at Forest Hills, intersecting Morton Street at Hyde Park Avenue on the easterly side of the tracks.

The roadway cross section in Segment three consists of a 10-foot sidewalk, four 12-foot travel lanes and a 10-foot sidewalk (see Fig. IV-62). A pedestrian drop area or kiss-and-ride slot will be provided for on the south-bound side of the arterial at the proposed Boylston Street Station.

4.4.6 Alternative FH-3 Rail/Transit On Modified Embankment No Arterial Street (Figure IV-34 thru IV-40)

The horizontal alignment between Camden Street and Ruggles Street would follow the existing Penn Central alignment which is on tangent. At present the tracks are on an embankment section beginning at existing grade in the vicinity of Gainsborough Street and ascending at a 0.36 percent grade through Ruggles Street. The existing embankment neither has sufficient width for the proposed five tracks, nor does it provide adequate height to allow for adequate vertical clearance over the local street. Therefore the width of the existing embankment would be increased and the height of embankment raised (see Fig. IV-62A).

The profile of the embankment section between Camden Street and Ruggles Street would be constructed on a grade of 1 percent. It would raise the elevation of the embankment approximately 2 feet within this section and the embankment would be in a retained fill section from Camden Street to Ruggles Street (Fig. IV-39 and IV-40). The railroad bridge over Ruggles Street would be replaced under this alternative. The proposed Ruggles Street Station would be located north of and adjacent to Ruggles Street.

South of Ruggles Street, the profile grade would be 1.0 percent followed by a 0.6 percent and a 0.0 percent grade. This will maintain the required vertical clearances at Prentiss, Station and Tremont Streets. At these locations new railroad bridges would be constructed. The elevations of the embankment would be raised in this area by approximately four feet. The proposed Roxbury Crossing Station would be located at Tremont Street. In this area, the rail/transit would be on a 1° (R=5730') horizontal curve to the left which extends from Tremont Street to New Heath Street (see Fig. IV-38 and IV-39).

The embankment section would continue south at relatively flat grades of 0.0, 0.7 and 0.5 percent which would add about one foot to the existing embankment. The horizontal alignment would transition from the 1° (R=5730') horizontal curve to a 600-foot-long tangent section. A 4000' R curve extends from Heath Street through Jackson Square to Roy Street. New bridges would be built over New Heath, Heath and Centre Streets. The proposed Jackson Square Station would be built between Heath and Centre Streets.

South of Jackson Square the horizontal alignment continues on a 1.4° (R=4000') curve to the right to the vicinity of Roy Street where a tangent section begins and extends to Hoffman Street. The alignment then curves left on a 1.4° (R=4000') to Paul Gore Street. A 1900-foot tangent section extends from Paul Gore Street to Cornwall Street followed by a 1°(R=5730') curve to the right to a point approximately 500 feet south of Williams Street. From that point the tracks follow a tangent alignment to a point 1500 feet north of Forest Hills where a short 5730' R curve to the left directs the tracks on a tangent alignment into the Forest Hills Station area. The vertical alignment in this section is made up of relatively flat grades (0.5 percent). The embankment would be raised an average of one to two feet (see Fig. IV-34 thru IV-37).

Replacement rail/transit structures would be built at Mozart, Boylston, Green, Williams, McBride and Morton Streets. A new rail/transit structure would be introduced at Minton Street where a pedestrian underpass.

The proposed stations in this section would be Boylston Street Station (Boylston Street), Green Street Station (Green Street) and Forest Hills Station located south of Morton Street.

Construction on local streets under this alternative would be limited to the areas around the proposed stations and any work necessitated by the replacement of rail/transit bridges over local streets.

4.4.7 Alternative FH-4, Rail/Transit on Modified Embankment, Arterial Street Crossing East to West (Fig. IV-41 thru IV-47)

West of the Massachusetts Avenue Station the horizontal alignment is on tangent to the vicinity of Ruggles Street (see Fig. IV-47). At present the tracks are on an embankment section beginning at existing grade near Gainsborough Street. They ascend at a 0.36 percent grade through Ruggles Street, but the existing embankment neither provides sufficient width for the proposed five tracks, nor does it provide adequate height to allow for proper vertical clearance over the local streets. Therefore, the width of the existing embankment would be increased and the height of embankment raised (see Fig.IV-62A). The profile of the embankment section between the Massachusetts Avenue Station and the Ruggles Street Station would be constructed on a grade of 1.0 percent. It would raise the elevation of the embankment an average of two feet within this section and the embankment would be in a retained fill section from Camden Street to Ruggles Street. The railroad bridge over Ruggles Street would be replaced and the proposed Ruggles Street Station would be located north of and adjacent to Ruggles Street.

The profile grade would be relatively flat south of Ruggles Street, maintaining the required vertical clearance at Prentiss, Station and Tremont Streets. At these locations, new railroad bridges would be constructed. The embankment would be raised approximately four feet above the elevation of the present embankment. The proposed Roxbury Crossing Station would be located at Tremont Street. In this area, the rail/transit is on a 4000-foot radius horizontal curve (see Fig. IV-45 and IV-46).

The embankment section (approximately three feet above the existing one) is continued south at a grade of 0.7 percent. The horizontal alignment transitions from the 4000-foot-radius horizontal curve to a 800-foot-long tangent section followed by a 4000' R curve through Jackson Square. New bridges will be built over New Heath, Heath and Centre Streets. The proposed Jackson Square Station will be built between Heath Street and Centre Street.

An arterial street system is developed in conjunction with the Orange Line Relocation. It originates at the Southeast Expressway ramps at Massachusetts Avenue and follows the route of the proposed but now abandoned I-95 to Ruggles Street, along the easterly side of the Penn Central tracks to Jackson Square. It continues to Boylston Street where there is an option either to remain on the easterly side of the tracks or to cross to the westerly side and to terminate at Forest Hills.

The route is generally defined as: beginning at Massachusetts Avenue parallel and south of Albany Street, curving westerly crossing Albany Street at Green Shoe Co., crossing Harrison Avenue at Webber Street, crossing Washington Street Street, Shawmut Avenue, Westminster Street and Warwick Street adjacent to Sterling Street. From this location the proposed arterial street alignment curves southerly across Tremont Street at Weston Street and is generally aligned with the Penn Central tracks at Ruggles Street. From Ruggles Street to Jackson Square the arterial street is parallel and adjacent to the easterly side of the Penn Central tracks. South of Jackson Square the alignment is still parallel and adjacent to the Penn Central tracks, but there is the option of being either east or west of the tracks south of Mozart Street and to terminate at Forest Hills.

The arterial street, for this study, was broken into three segments:

> Segment one: That part of the arterial street route from the South east Expressway ramps at Massachusetts Avenue to Ruggles Street. The proposal which is being advanced as a non-major action project, calls for a four-lane facility following the general alignment of the corridor cleared for the abandoned Boston Inner Belt.

Segment two: From the end of segment one at Ruggles Street along the easterly side of the Penn Central tracks to Jackson Square.

Segment three: From the end of Segment two at Jackson Square along the easterly side of the Penn Central tracks to Mozart Street. From Mozart Street there is an option to either continue the arterial street on the easterly side of the track to Forest Hills or to cross under the tracks and locate the arterial street on the westerly side of the tracks and terminate at Forest Hills.

Segment one, as noted previously, has been declared a non-major action project and will be designed and constructed as proposed. Segment two is not essential to the feasibility of Segment one which is capable of standing alone as a complete project.

The arterial street being proposed for Segment two is a six-lane arterial beginning at Ruggles Street, located parallel to and east of the Penn Central alignment (see Fig. IV-45 thru IV-47). The arterial street would closely follow the Penn Central alignment which in this area is almost totally on a 4000-foot radius curve.

The roadway cross section for Segment two consists of sidewalk and planting strip, three travel lanes, a raised median, three travel lanes and a sidewalk and planting strip. Variations in the median width occur at the following intersections for the purpose of accomodating left-turn storage lanes: Ruggles, Tremont, Heath and Centre Streets. Variations in the sidewalk and planting strip would also occur as part of green-space and land-development considerations.

A pedestrian drop area or kiss-and-ride slot would be provided for on the arterial at Roxbury Crossing Station.

The major intersections at Tremont, Ruggles, New Heath, Heath and Centre Streets would be signalized.

Segment two of the proposed arterial street can be designed and constructed to function properly without Segment three (see Figure IV-45A).

South of Jackson Square the horizontal alignment of the rail/transit facility continues on a 1.4° (R=4000') curve to the right to the vicinity of Roy Street where a tagent section begins and extends to Hoffman Street. The alignment then curves left on a 1.4° (R=4000) to Paul Gore Street. A 900-foot tangent section extends from Paul Gore Street followed by a 5730' R curve to the left and a tangent extending to Cronwall Street followed by a 1° (R=5730') curve to the right to a point approximately 500 feet south of Williams Street. From that point to Forest Hills the tracks follow a tangent alignment (see Fig.IV-41, IV-44). The profile of the rail/transit facility in this area is made up of relatively flat grades which would raise the elevation an average of three feet.

Replacement rail/transit structures will be built at Mozart, Boylston, Green, Williams, McBride and Morton Streets. A new rail/transit structure will be introduced at Minton Street where there is a pedestrian underpass and potentially at Mozart Street where the arterial street would pass under the railroad.

The arterial street option developed for Alternative 4 for the section between Jackson Square and Forest Hills has been designated Segment three. This option is dependent upon the construction of Segment two although this segment can stand alone as a viable option.

Beginning at Jackson Square, which is the southern limit of Segment two, the arterial would change if constructed from a six-lane divided roadway to a four-lane undivided roadway. The arterial road is aligned parallel and adjacent to the tracks on the eastern side to Mozart Street. Here, the arterial crosses under the Penn Central tracks. The arterial street is then aligned essentially parallel, and west of the track from Boylston Street to Forest Hills. At Forest Hills the arterial street crosses under the rail/transit facility and intersects Morton Street at Hyde Park Avenue. A traffic system has been developed at Forest Hills to allow for the free movement of traffic between Hyde Park Avenue, Washington Street, Morton Street and the proposed arterial street.

Under this alternative the streets which would underpass the railroad are Mozart, Boylston, Minton, Green, Williams and Morton. Changes in the existing street pattern within the Corridor include the relocation of Albert Street. Lamartine Street would be closed at Paul Gore Street south of Boylston Street. This would eliminate any through movement on Lamartine Street between Paul Gore Street and Hubbard Street. A short access road would be constructed between Lawndale Terrace and Lamartine Place parallel to the arterial street. A cross street would be constructed from Amory Street opposite Minton Street, under the tracks to the arterial road. Oakdale Road would be dead-ended midway between Cerina Road and Green Street. McBride Street would have an improved connection with Call Street on the west side of the tracks.

4.4.8 Alternative FH-5, Camden Street to Forest Hills - Modified Depressed Rail/Transit, Arterial Street East (Figs. IV-48 through IV-55)

In this alternative, the proposed track grade would be depressed to approximately a level above the existing ground water. The present railroad embankment, as in Alternatives FH-1 and FH-2, would be removed from Gainsborough Street in Back Bay to Forest Hills.

Horizontal alignment of the rail/transit facility would be as follows:

Chickering (Camden Street) to Tremont Street	Tangent
Tremont St. to north of New Heath Street	R=4500' (D=1° 15' $\pm$)
North of New Heath St. to relocated Heath Street	Tangent
Relocated Heath St. to Roys Street	R=4500' (D=1° 15' $\pm$)
Roys Street to Hoffman Street	Tangent
Hoffman Street to Mozart Street	R=6000' (D=1° $\pm$)
From Mozart Street to South of Boylston Street	R=6000' (D=1° $\pm$)
From south of Boylston Street to Cornwall Street	Tangent
From Cornwall Street to Gordon Road	R=6000' (D=1° $\pm$)
From Gordon Road to Relocated Washington Street	Tangent
From Relocated Washington Street to End of Project (Dell More Road Vicinity)	R=6000' (D=1° $\pm$)

Horizontal curvature for the tracks would have a minimum of R=4500 feet and a maximum of R = 6000 feet.

Passenger stations for the Orange Line would be located at the following street locations: Ruggles, Tremont (Roxbury Crossing), Centre (Jackson Square), Boylston, Green and Forest Hills. The station at Forest Hills would be the terminal point for the relocated Orange Line as well as for the Green Line and would have transfer facilities to the commuter rail. The station at Ruggles Street would also provide for connections to commuter rail service.

Continuing from the South Cove Alternatives (SC-1 and SC-2), the railroad grade would extend on level grade through the proposed passenger platform at Ruggles Street. Then it would ascend on a 0.5 percent grade, pass the Orange Line station at Roxbury Crossing, and continue to Cedar Street. From Cedar Street, it would then level off to zero percent to New Heath Street. After climbing at 0.5 percent from New Heath Street to Jackson Square, the track grade would return to level between Center Street and Mozart Street.

The depressed railroad tracks would descend at 0.25 percent from Mozart Street pass the Boylston Street station to Lorene Place. From there, the track grade would climb at 0.3 percent, through the Green Street station, to the vicinity of Williams Street. It would then level off at 0.0 percent and continue to Forest Hills station. Once past the Forest Hills station, the tracks would then ascend at 0.7 percent until they climb out of the depression and merge with the existing 4 tracks in the vicinity of Dell More Road in Hyde Park.

The two Needham Branch tracks, once separated from the mainline, would ascend at 1.5 percent grade until they meet the existing tracks on the present embankment, approximately 2,000 feet from the Washington Street portal.

The Orange Line grade, as in previous segments, would be generally parallel and approximately three feet higher than the railroad for the entire length.

South of the Forest Hills station, the Green-Line tracks would cross over the relocated Washington Street, at grade, to a yard with storage tracks in the present city parking area south of Asticou Road. The Orange Line would climb up at 4 percent grade, under the relocated Washington Street, to a yard

to the west of the Needham Branch tracks and at approximately the same level as the Green-Line yard. Four storage tracks would be provided for the Orange Line.

Once out of the restricted right-of-way in the Back Bay area, the tracks would return to the normal spacings from Chickering to Forest Hills. Tracs would be spaced 13 feet on centers for the Relocated Orange Line and 14 feet on centers for the railroad, with a minimum of 17 feet between the lines. The vertical clearance of 19 feet and 7 inches would be maintained under all structures crossing the depressed railroad. A low wall, or slope, would separate the Orange Line from the railroad in the depressed section.

An arterial street similar to the one in Alternative FH-2 would also be provided in this alternative. Generally paralleling the new tracks, this arterial would be a new street beginning at Ruggles Street ending at Forest Hills. The arterial street would remain on the east side of the tracks and would have the same design features as described in Alternative FH-2.

Because of the grade of the new tracks (at or above the ground water level) and their proximity to the arterial, the arterial would be set approximately 24 feet above the tracks at the crossings in order to have a 19' - 7" clearance. Local streets such as Ruggles, Tremont, Cedar, Heath, Centre, Mozart, Boylston, Green, Gordon, Williams, McBride and Morton would be raised to meet the new grades.

Prentiss, Station, and New Heath Streets would be terminated at the new railroad right-of-way. Provisions would be made for emergency vehicles to cross over the proposed deck at Prentiss Street. Lamartine Street would be relocated with its section between Roys and Hoffman closed. Oakdale Street would be terminated north of Green Street. Call Street between Williams and McBride would also be realigned.

New bridges to carry local streets over the depressed tracks would be constructed. In some areas, pedestrian overpasses would be useful to local residents. In this Alternative, the following bridges and overpasses would be constructed:

Ruggles Street
Prentiss Street
(pedestrian)
Tremont Street
Cedar Street
Heath Street
Centre Street
Mozart Street
New Heath Street
(pedestrian)

Paul Gore Street
Boylston Street
Lorene Place
Cornwall Street
(pedestrian)
Green Street
Gordon Street
Williams Street
McBridge Street
Morton Street
Washington Street

The new spans would be shallow and would have an intermediate support between the railroad and the Orange Line. The abutments would be flush with the retaining walls. The girders for these spans would be of structural steel, prestressed, precast concrete with reinforced concrete decks and asphalt concrete pavement.

Decks over the depressed railroad, which would act as sound barriers and which could be designed for recreational and other uses for local communities, would be constructed at these locations:

From Ruggles Street to Prentiss Street
From Heath Street to Centre Street
Mozart Street
Boylston Street
Green Street
Forest Hills

The existing Orange Line car shop south of the present Forest Hills station would be demolished at the appropriate time with all operations transferred to Wellington car shop. The alternative includes the demolition of the present Orange Line overhead structure on Washington Street for its entire length.

Approximately 14 existing bridges and sections of retaining walls along the present railroad embankment would be demolished in the Alternative. These structures are constructed of granite block and structural steel girders which could be reused or salvaged as much as possible, for the construction of new walls, new bridges, and station facades.

4.4.9 Alternative FH-6, Camden Street to Forest Hills - Modified Depressed Rail/Transit, No Arterial South of Jackson Square (Figs. IV-56 through IV-60)

The rail/transit facility proposed in this Alternative is identical to the one proposed in Alternative FH-5. The difference between the two alternatives is the extent of the arterial street construction. Alternative 6 does not construct the arterial street south of Jackson Square but terminates it there. Alternaitve 6a represents a slight modification in that it allows connections to Columbus Avenue.

As stated previously, the arterial street proposed from Massachusetts Avenue to Forest Hills could be constructed in segments. Segment one (from Massachusetts Avenue to Ruggles Street) and Segment two (from Ruggles Street to Jackson Square) could be constructed to function properly without Segment three (from Jackson Square to Forest Hills).

In this Alternative, the Arterial between Ruggles Street and Jackson Square (Segment two) would be included. Between Jackson Square and Forest Hills, local streets such as Mozart, Paul Gore, Boylston, Lamartine, Lorene, Cornwall, Green, Gordon, Amory, Williams, McBride, Call, Morton and Washington would be modified in order to be compatible with the new depressed rail/transit facility, but would not connect to a new arterial.

4.4.10 Passenger Stations

4.4.10.1 Back Bay Station (See Fig. IV-70 to IV-73)

The Back Bay Station is planned to serve as a major transportation gateway to the City of Boston. It would provide a principal in-town modal change facility serving the Back Bay, South End, and St. Botolph districts. It would accommodate convenient and efficient passage between intercity and commuter rail as well as transit, local bus, taxi and automobile drop-off.

Located in an area with both major existing commercial facilities and the potential for extensive future development, the proposed Back Bay Station would have a scale and commodity (approx. 42,000 sq. ft.) appropriate to its anticipated high level of use. It would be constructed at the site of the existing Back Bay Station. The station is located at the border between the major retail, office, and institutional facilities of the Back Bay, and, the chiefly residential districts of St. Botolph Street and the South End. Further, it is located in the border area between the National Historic Districts of the Back Bay and South End. As such, the Station's architectural character should respond to the unique scale, detail, and distinctive qualities of the site.

The proposed Station would assume an atrium form with a skylit central space rising two stories to the roof. This central space or atrium (12,000 sq. ft.) is the principal waiting and staging area from which access to the various transit and railroad lobbies and platforms (Orange Line Transit, AMTRAK, commuter rail, B&A) is provided. As the point of entry to Boston for many travelers and commuters, it should provide a particularly pleasing and well-appointed experience.

In regard to the configuration of the station, at street elevation, there is no significant difference between the transit and rail-at-grade alternative and the transit-in-tunnel alternative. The specific configuration of the transit lobby, and access to corresponding platforms would vary slightly in response to the platform location in each instance. The lobbies and platform access points for the Orange Line Transit, Commuter Rail, AMTRAK, B&A, would be positioned on the perimeter of the atrium. A number of station-entrance points, operational, informational, and concession services would also be positioned there.

In the proposed station, there are three primary points of entrance to the lobby. The main pedestrian entrance to the station would be located on Dartmouth Street with direct access to the transit lobby. Waiting vehicles would be accommodated by a vehicle zone for drop-off and short-term parking. Direct access to the station from this vehicle zone is provided by a pedestrian plaza appropriate for the transfer of passengers and their baggage between the station and waiting vehicles. An existing pedestrian bridge from the John Hancock parking garage has been provided with direct access to permit convenient use of its long-term automobile storage.

In both of the proposed station alternatives, vertical circulation would provide access to the platforms by means of escalators and stairs. Elevators would be provided for the handicapped. In both station alternatives all platforms are high. This permits direct access to all trains without a level change. (All changes must be made at lobby level, no cross-platform transfer is possible.)

In the transit-and-rail-at-grade alternative, the Orange Line would have one end-loaded island platform, 410-feet long and varying in width from 23 to 18 feet. The two AMTRAK and commuter-rail platforms would be end loaded and work side by side as center and side-platforms, 1200-feet

long, serving three tracks. A B& A center-loaded island platform could be provided in the future. In the same alternative, the vertical circulation provides direct access to all platforms one level below.

In the second alternative (transit in tunnel) the Orange Line would have two end-loaded side platforms, 410-feet long varying in width, from 35 to 25 feet. The two AMTRAK and commuter-rail platforms, again, would be end loaded and work side by side as center and side platforms 1200-feet long, serving three tracks. A B&A center-loaded island platform could be provided in the future. In the same alternative, the circulation passes through two lower levels. At the first, the AMTRAK and commuter-rail platform level, it provides direct access to those platforms. Further, at this level it provides controlled access between the AMTRAK and commuter-rail platforms and the transit platforms by means of unattended turnstiles. At the transit-platform level, it provides direct access to the transit platforms. In both alternatives, the transit and rail platforms are provided with an unsupervised exit only to permit direct exit from the platform below the intersection of Clarendon Street and Columbus Avenue.

The local street pattern in the vicinity of the station should be modified slightly to permit clear and efficient vehicle access to the station. Specifically, the intersection of Buckingham Street, Columbus Avenue and Clarendon Street would be modified by relocating the Buckingham Street leg of that intersection to the edge of the John Hancock Garage at Clarendon Street. This clarifies the intersection of Clarendon and Columbus, making it a standard four-legged intersection, and permits the introduction of an exit plaza providing access to the transit and rail platforms below. Further, Buckingham Street would provide access to an auto drop-off lane and taxi lane in a vehicle zone permitting adequate holdover space adjacent to the pedestrian plaza.

The proposed station would be constructed of cast-in-place, reinforced concerete columns and coffered slab. The feasibility of columns, footings and slab seats capable of supporting appropriate air-rights decks in a clear and efficient manner should be investigated. Appropriate durable, vandal-resistent materials and finishes such as brick, concrete, ceramic tile, steel and glass should be used throughout. Architectural elements such as skylights and clear-stories as well as materials such as glass block should be used wherever feasible to introduce natural light and ventilation.

The design of the station has responded to the potential for related joint development. With the necessary structural capabilities, the station could combine air-rights development such as office space, either in conunction with the initial construction or coordinated at some future point in time. Further, the entrances to the station have been positioned so as not to preclude the development potential of adjacent sites. Related concession and commercial space would be incorporated, to introduce vitality in the station lobby.

<u>4.4.10.2 Massachusetts Avenue Station</u>: (See Fig. IV-74)

The Massachusetts Avenue Station would be an Orange Line transit station providing some local bus access and no commuter rail or AMTRAK service. It would provide service to the South End, St. Botolph Street area and Fenway districts and it would be used heavily by pedestrians.

The station site would be in an underutilized parking lot to the rear of the Boston Arena and fronting onto Massachusetts Avenue. It is in an area of mixed commercial and residential structures with some prominent rehabilitation, as well as cleared and vacant parcels. The area is adjacent to the institutional resources of Northeastern University, the New England Conservatory, the Berkeley School, and the Christian

Science Center as well as Symphony Hall and Horticultural Hall. Further, it is adjacent to Carter Playground and the proposed City of Boston Middle School.

The Regional Trail would meet Carter Playground, and be provided with access to the station by a reconstructed pedestrian bridge at Gainsborough Street and rampt to the station lobby and Massachusetts Avenue. The possibility of easements to provide a direct open space accessway from Carter Playground to Claremont Street should be examined in coordination with more detailed aspects of the project.

The station would provide an at-grade lobby in a single pavilion. It would permit pedestrian access to Massachusetts Avenue and bus berths would permit the transfer of passengers without impeding the flow of traffic.

There is little significant difference in the functional plan of the alternatives. Principally the alternative in which the tracks are at existing grade, the station would be at grade with a pedestrian-activated signal crossing to permit safe access from the in-town side of Massachusetts Avenue. In the alternative suggesting depressed tracks, the station would be slightly below grade in the same location, with a pedestrian tunnel to provide grade-separated pedestrian access to the in-town side of Massachusetts Avenue.

Access to all platforms would be provided with an adequate number of stairs and ramps appropriate for the handicapped. The transit platform would be an island platform, 410-feet long and 30-feet wide, with an unattended exit to permit access to a pedestrian bridge at Gainsborough Street.

There would be no significant change in the local-street network. The proposed station and all other stations in the proposed project and its alternatives (Back Bay Station is an exception) would have the same construction. Construction would be cast-in-place, reinforced columns and coffered slab with floor or deck areas of high regularity and integral beams seating precast T sections. Durable, vandal-resistant material such as brick, concrete, steel, and ceramic tile should be used throughout. Architectural elements such as skylights and clearstories, as well as materials such as glass block should be used wherever feasible to bring in natural light and ventilation.

The design of the station responds to the potential for related joint development. Its relationship between adjacent development parcels and to Massachusetts Avenue, which is the primary shopping district, provides for maximum interface. Related commercial space could be incorporated into the station's design particularly that portion which would front Massachusetts Avenue.

The Boston Arena is a major resource to provide recreational and athletic facilities to the area. The station could provide for a future direct connection to the Arena. The station, would therefore, encourage the use of the Arena and would draw additional riders to the proposed transit facility.

<u>4.4.10.3 Ruggles Street Station</u>: (See Fig. IV-75 to IV-77)

The Ruggles Street Station would be a major modal-change facility serving both proposed and future transportation modes. It would accommodate the proposed Orange Line Transit and Commuter Rail Lines, and serve local buses, vehicles from local streets and the proposed arterial street. Particular emphasis has been placed on the facility as a major local bus terminus. Further it would accommodate a proposed

cross-town grade-separated transit link in the future. The station site is located within the Roxbury district of the corridor, an area subject to the most significant clearance. This area should be able to support extensive development in the future. In this capacity, the station has been designed to support the efficient transfer of a large number of anticipated passengers and vehicles,and to allow future joint development.

The station site is cleared and used in part for surface parking. It is located adjacent to Northeastern University and is near the institutional resources of the Fenway district. It is adjacent to Mission Hill and Whittier Street Public Housing. The proposed Regional Trail would follow adjacent to the tracks from Forest Hills and meet the station at Ruggles Street. Similarly, Columbus Avenue would provide the South End with pedestrian access to the station at Ruggles Street. These factors indicate that the station site would be approached from these directions by a substantial number of pedestrians and that appropriate vehicle free zones should be provided.

The station configuration is essentially a pedestrian island, surrounded by the necessary vehicle loops and bus berths. A sufficient pedestrian plaza and cover would be provided to maintain clear movement and transfer in all weather conditions. The station area would be a major bus terminus with transfer and layover capabilities. Waiting vehicles would be accommodated on the perimeter of the pedestrian plaza. Buses would be provided with special berths for the transfer of passengers and the layover of appointed bus routes.

There is little significant difference in the functional station design of any of the alternatives (land use and environmental differences are described in 7.4). In the tracks-depressed alternatives, vertical circulation would provide access to the platforms below. In the tracks-elevated alternative, vertical circulation would provide access to the track and platform deck above. In the second alternative, the platform above it would serve as a canopy to the bus plaza.

The station lobby would consist of two pavilions joined by a breezeway (covered pass through). It would permit access to Ruggles Street at one end and to the bus plaza at the other. Skylights in its cover and along its edges would permit introduction of natural light to commuter-rail platforms below. As one enters from the bus plaza, access to the inbound commuter rail platform would be in the minor pavilion on the left. Access to the outbound commuter-rail and transit platform would be in the major pavilion on the right.

In the alternatives, the platform access and configuration for both transit and rail lines is essentially the same. In the major pavilion there would be two points of entrance, one at Ruggles Street and the other on the breezeway. In the minor pavilion there would be one entrance, also on the covered breezeway. The correspondent lobbies and platform-access points for the Orange Line transit and commuter-rail line would be located in either pavilion.

Access to all platforms would be provided with an adequate number of stairs and ramps appropriate for use by the handicapped. In the proposed system, all platforms would be high, permitting direct access to all trains without a level change. All changes would be made at lobby level. No cross platform transfer would be possible. The transit platform would be an end-loaded island platform, 410-feet long and 30-feet wide, with an unattended exit to permit access to a bus plaza above. The two commuter-rail platforms would be center-loaded side platforms, 1040-feet long and 20-feet wide. Further, in both alternatives there would be provisions in the design of the station for the necessary platforms and platform access for a future crosstown transit link.

The local-street pattern in the vicinity of the station should be modified in coordination with the arterial street plans. The proposed loop permits clear and efficient vehicle access to the station. Access to the loop is possible from local streets (Ruggles Street and Columbus Avenue) as well as from the proposed Arterial Street. In the tracks-depressed alternatives,both Ruggles Street and the loop would be constructed in coordination with the station deck. In the tracks-elevated alternative,the same roads would be constructed by a cut in the embankment with the track and platform deck above. In all alternatives, the proposed Regional Open Space Trail would pass through the station site to meet Carter Playground in the South End by means of Columbus Avenue.

The design of the station site responds to the potential for related, joint development with provisions for direct pedestrian station access. The station should be of a character that will tie the existing communities with the facilities of Northeastern University in an appropriate manner. Its related development should provide an identifiable gateway to Northeastern and an interface to local community development on the adjacent cleared land. To this end, column seats and footings would be provided where feasible for future construction.

This intersection of the various transportation modes (Orange Line) rapid transit commuter rail, local bus and arterial street) that intersect at this point indicates an anticipated high level of use. The relationship of the station, as well as its entrances and pedestrian plaza, to the surroundings provides the maximum interface with one of the most prominent adjacent development parcel in the Southwest Corridor.

4.4.10.4 Roxbury Crossing: (See Figs. IV-78, IV-79 and IV-88)

The Roxbury Crossing Station would act as a principal Orange Line transit station which would provide some local bus access and no commuter rail or AMTRAK service. It would provide service to Roxbury, and specifically, to Campus High School. Pedestrians would find it very convenient with appropriate pedestrian bridges to provide grade-separated crossings and access to the station.

The station site is in an area of extensive clearance. It is an area of mixed commercial and residential districts as well as prominent existing and proposed academic facilities. It is adjacent to Campus High School, currently being built, and the proposed Roxbury Community College site. The proposed Regional Open Space Trail would pass through the station site adjacent to the tracks.

The station, as planned, would provide an at-grade lobby in a single pavilion. It permits pedestrian access from Tremont Street. Bus berths permit buses to transfer passengers without impeding the flow of traffic. Related commercial space, such as a newstand, have been incorporated in its design.

There is little significant difference in the functional station design of the alternatives. Principally, in the tracks-depressed alternatives the vertical circulation provides access to the platforms below. In the tracks-elevated alternative the vertical circulation provides access to the track and platform deck above.

In both alternatives, a pedestrian bridge crossing over the Arterial Street (relocated Columbus Avenue) would provide safe access from the station to the site of Campus High School. Access to all platforms would be provided with an adequate number of stairs and ramps appropriate for use by the handicapped. The transit platform would be an end-loaded island platform, 410-feet long and 30-feet wide.

The local street pattern in the vicinity of the station would be modified in coordination with the Arterial Street plans. In the tracks-depressed and modified-depressed alternatives, Tremont Street would be constructed in coordination with the station deck. In the tracks-elevated alternative, it would be constructed by cutting through the embankment with a track and platform deck above. In both alternatives the proposed Regional Trail would pass through the station site, in coordination with street plans.

The design of the station takes into account the potential for related joint development. Its relationship to Tremont Street, the primary shopping street in the district, provides the maximum interface between both. Special efforts should be made to tie the existing neighborhood with proposed academic facilities in order to encourage community continuity.

4.4.10.5 Jackson Square Station: (See Figs. IV-80 to IV-83, IV-88)

The Jackson Square Station would be an Orange Line transit station providing some local bus access and no commuter rail or AMTRAK service. It would provide service to Roxbury and Jamaica Plain. It would be most useable to pedestrians. Necessary vehicle loops and bus berths, however, would be provided for the transfer of passengers and the holdover of appointed routes.

The station site is in an area of mixed commercial and residential districts with some manufacturing and industry. The site is adjacent to the Bromley-Heath public housing project. In the depressed alternative,

a playground deck which would be built over the station, would shield the housing project from rail and transit noise (especially the upper stories). Further, it would provide extended facilities for the Albert Street Playground, which is insufficient for the level of use imposed by the high density of the housing in the area. The proposed Regional Trail would follow adjacent to the tracks and pass through the station area with access to the playground deck.

The station configuration is essentially a pedestrian island surrounded by necessary vehicle loops and bus berths. A pedestrian plaza and cover, furnished by the playground deck, would be provided to maintain clear movement and transfer in all weather conditions. The station would provide an at-grade lobby in two pavilions. The major pavilion would permit pedestrian access from Centre Street and the pedestrian plaza. Related commercial space would be incorporated in design. The minor pavilion would permit pedestrian access from Heath Street and the pedestrian plaza.

There is little significant difference in the functional station design of the alternatives. Principally, in the tracks-depressed alternatives the vertical circulation would provide access to the platforms below. In the tracks-elevated alternative, the vertical circulation would provide access to the track and transit platform above, but no playground or acoustic deck would be provided.

Access to the transit platform would be provided with an adequate number of stairs and ramps appropriate for use by the handicapped. It would be an island platform, 600-feet long and 30-feet wide, with access at each end.

The local street pattern in the vicinity of the station would be modified in coordination with the proposed arterial street plans. In the Arterial-Street-through-Jackson-Square alternative, it would follow through the station site adjacent to the tracks. In the Arterial-Street-to-Jackson-Square alternative, it would either pass through the station site adjacent to the tracks and stop at Centre Street and would connect directly to Columbus Avenue. In the Arterial-to-Forest Hills-Alternative, it would continue along the rail right-of-way. In the tracks-depressed alternatives, Centre and Heath Streets would be reconstructed in coordination with the station. In the track-elevated alternative, the same street would be reconstructed by cutting through the embankment with the track and platform above. In all alternatives the proposed Regional Trail passes through the station site and provides pedestrian access to it.

The design of the station responds to the potential for related joint development. The relationship of Centre Street (the primary shopping street in the district) to the major station lobby permits the maximum interface between both, with continuity of commercial space between the existing and proposed.

<u>4.4.10.6 Boylston Street Station (see Fig. IV-84 to IV-87, IV-88)</u>

The Boylston Street Station would be on Orange Line Transit station providing some local bus access and no commuter rail or AMTRAK service. It would provide service to Jamaica Plain and would be applicable for use by pedestrians, approximately 15 spaces for short-term parking for waiting autos, as well as bus berths for the transfer of passengers would be provided.

The station site is located in an area of small-scale mixed residential and commerical districts with occasional manufacturing and industrial districts on the east side of the tracks. Presently, there are substantial temporary recreational and open-space facilities located adjacent to the west side of tracks. The proposed Regional Trail would follow adjacent to the tracks and pass through the station area with access to those facilities when they become permanent. A sufficient pedestrian plaza would provide access to an at grade lobby. Related commercial space could be incorporated in the station.

There is little significant difference in the functional station design of the station alternatives. In the arterial east tracks-depressed alternatives, and the no-build arterial tracks-depressed alternative vertical circulation provides access to the platform below. In the tracks-elevated alternative No-build arterial alternative it provides access to the track and platform deck above.

Access to the transit platform would be provided with an adequate number of stairs, escalators, and ramps appropriate for use by the handicapped. It would be an end-loaded island platform, 410-feet long and 30-feet wide.

The local street pattern in the vicinity of the station should be modified in coordination with the proposed arterial street plans in the corresponding alternatives. In the arterial-east alternatives, it would follow adjacent to that side of the tracks and provide vehicle access to the station. In the arterial no-build alternatives, the local streets would not be altered except for necessary station access.

In the tracks-depressed alternative, Boylston Street and Paul Gore Street would be constructed in coordination with the station. In the tracks-elevated alternative, the same cross streets would be constructed by means of a cut in the embankment with the track and station platform above. In all alternatives the Regional Trail would pass through the station site.

The design of the station would encourage some small-scale commercial development to provide vitality to the station. The relationship of the station lobby to Lamartine Street which is the primary shopping area will permit the maximum interface.

4.4.10.7 Green Street Station (see Fig. IV-88 thru IV-92)

The Green Street Station would be an Orange Line transit station providing some local bus access and no commuter rail or Amtrak service. It would provide service to Jamaica Plain and would be very useful to pedestrians. It would provide approximately 15 spaces for short-term parking, parking for waiting autos, as well as bus berths for passenger transfers.

The station site is located in an area of small-scale mixed residential and commercial districts with occasional manufacturing and industrial districts adjacent to the tracks. One of such districts, the Boston Gas site, is currently under study for modification and use as Southwest II High School. The proposed high school and playfields would be located between McBride Street and Green Street abutting the east side of the tracks. Further, the proposed Regional Trail would follow adjacent to the tracks, and it would provide pedestrian access from the station to these facilities.

A pedestrian plaza would provide access to an at grade lobby. Related commercial space could be incorporated with the station in the future.

It would extend 1700 feet adjacent to both relocated Washington Street and Hyde Park Avenue at each end, a two way connector (relocated Morton and Walk Hill Streets) have been provided to permit traffic to flow around the complex in a continuous loop. It would be a major bus terminus with transfer and lay-over capabilities for various routes. Waiting vehicles would be accommodated on the perimeter of the pedestrian island. Buses would be provided with a special berth for the transfer of passengers, and the layover of appointed bus routes. The berths would be provided with sufficient cover to maintain a high level of service in all weather conditions.

There is little significant difference in the functional station design alternatives. Principally, in the tracks-depressed alternatives the vertical circulation provides access from the lobby and bus concourse level to the platforms below. The same alternatives provide a parking deck for 500 cars on a single floor covering the complex. Related commercial development would be provided in the lobby at the Hyde Park Avenue level.

The proposed parking decks for both of the alternatives provide for the parking of a minimum number of cars. If the Orange Line is not extended and Forest Hills becomes the last station on the line, additional space could be provided later for an additional 1,000 vehicles. This could be accomplished with two decks which would cover the entire complex.

The station lobby is located on the in-town northern end of complex. In both alternatives access from the Washington Street side is at grade. In the tracks-depressed alternative access from the Hyde Park Avenue side is provided by a grade separated pedestrian bridge at one level above grade crossing Hyde Park Avenue. All platforms provide stairs and ramps for use by the handicapped. In the proposed system all platforms would be high, permitting direct access to all trains without a level change. All transfers would be made at lobby levels. No cross platform transfer would be possible. The transit platform would be an end-loaded center platform, 440- feet long and 30-feet wide. The two Commuter-Rail platforms would be end-loaded side platforms, 1040-feet long and 20-feet wide. The Green Line Station would consist of an off-street loop, layover tracks and storage facilities.

The local street pattern in the vicinity of the station would be modified in coordination with the pedestrian island and vehicle loop. Further, it would be modified to coordinate the arterial street if the street is built in the future. Access to the loop would be from local streets as well as the arterial, if built. In the tracks-depressed alternatives the two-way connectors at either end of the station complex would be constructed in coordination with the station deck. In the tracks-elevated alternatives, the same roads would be constructed by a cut in the embankment with the track and platform deck above.

The design of the station complex has incorporated related joint commercial development and is sympathetic to the potential for these developments on adjacent sites. The station and its corresponding commercial development should be of a character that will tie existing commercial development to the entire complex. The intersection of the various transportation modes (Orange Line and Green Line transit, Commuter Rail, local bus and possible Arterial Street) that intersect at this Point, indicates an anticipated high level of use. The station as designed would be appropriate to such use.

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-1
(CAMDEN STREET to FOREST HILLS)

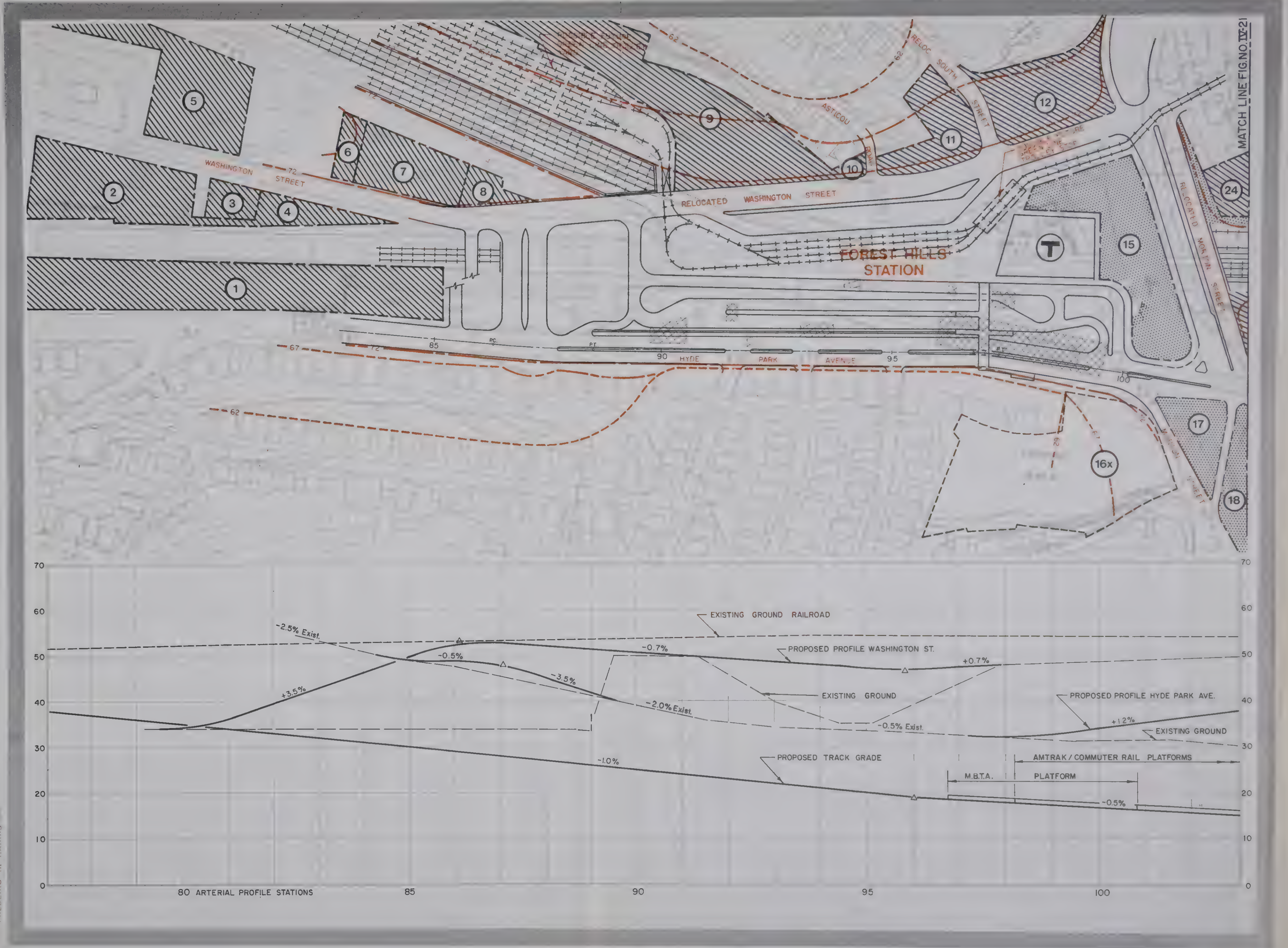
DEPRESSED RAIL / TRANSIT NO ARTERIAL STREET

LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- T PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE
NORTH
0 100 200 300

FIGURE IV-20



FREDERIC R. HARRIS

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-1

(CAMDEN STREET to FOREST HILLS)

DEPRESSED RAIL / TRANSIT NO ARTERIAL STREET

LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE

0 100 200 300

NORTH

FIGURE IV-21

FREDERIC R. HARRIS INC

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-1

(CAMDEN STREET to FOREST HILLS)

DEPRESSED RAIL / TRANSIT NO ARTERIAL STREET

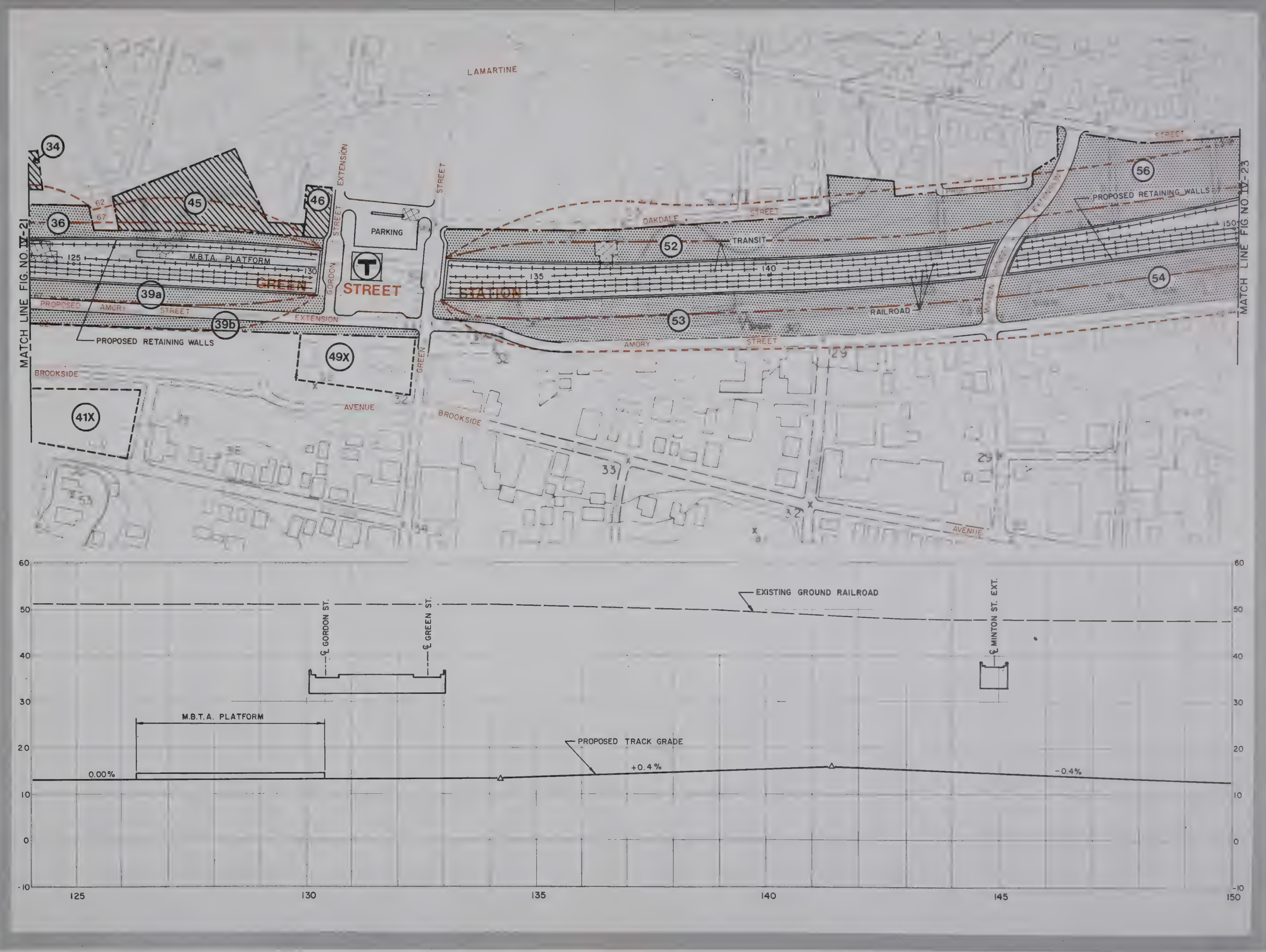
LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE

0 100 200 300

FIGURE IV-22



SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-1
(CAMDEN STREET to FOREST HILLS)

DEPRESSED RAIL / TRANSIT NO ARTERIAL STREET

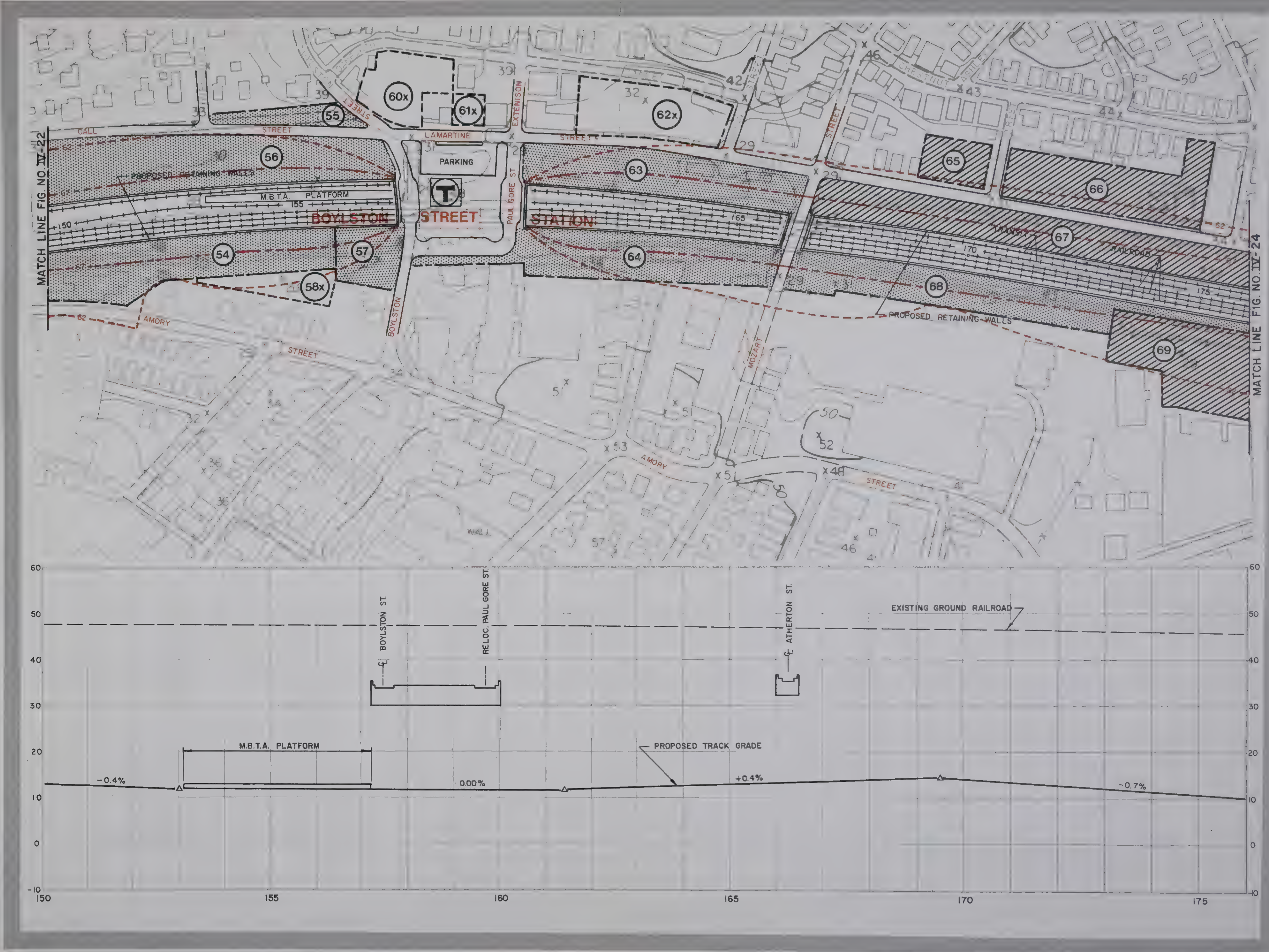
LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

NORTH

SCALE
0 100 200 300

FIGURE IV-23



SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-1
(CAMDEN STREET to FOREST HILLS)

DEPRESSED RAIL / TRANSIT
NO ARTERIAL STREET

LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE
0 100 200 300

FIGURE IV-24

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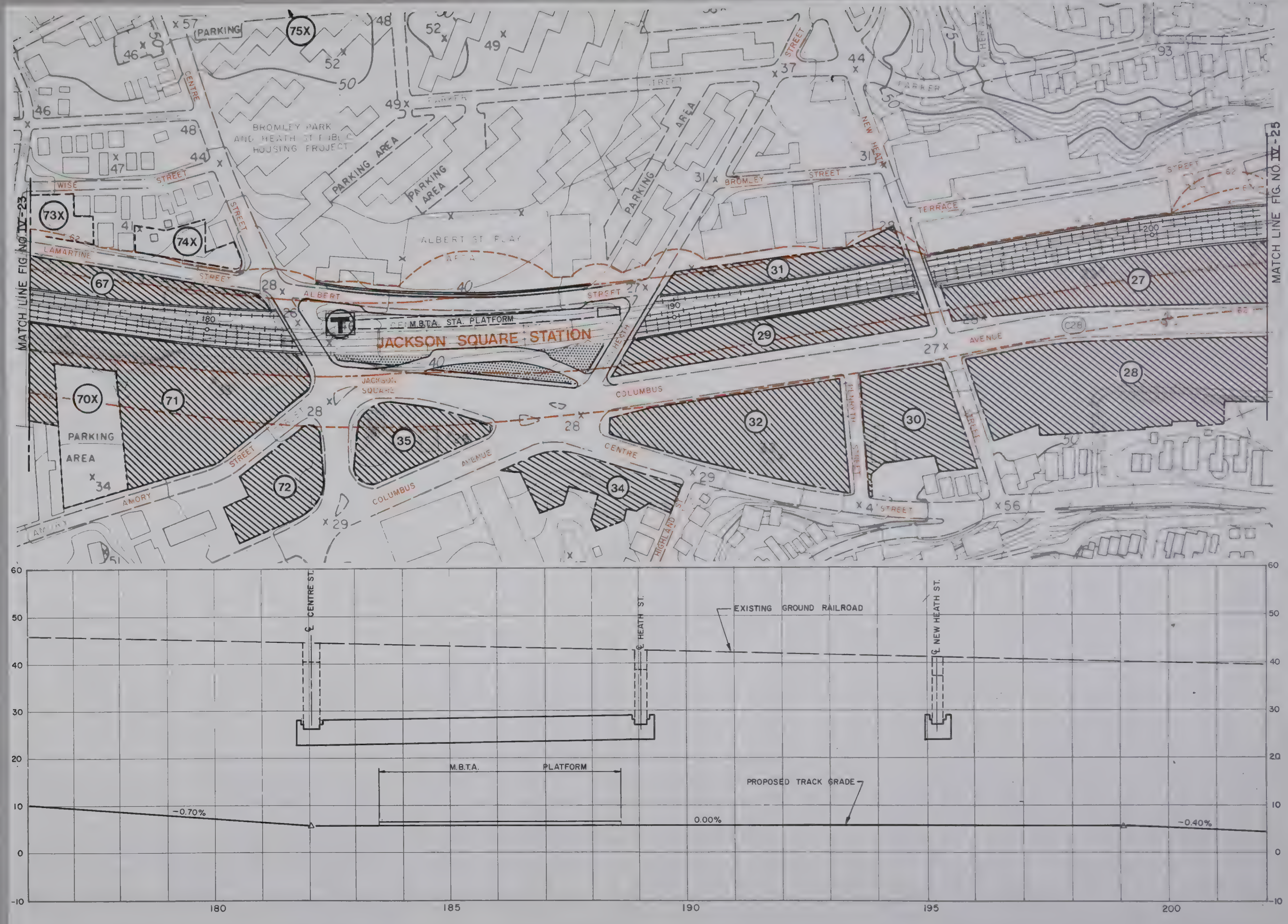


SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-1

(CAMDEN STREET to FOREST HILLS)

DEPRESSED RAIL / TRANSIT NO ARTERIAL STREET

LEGEND

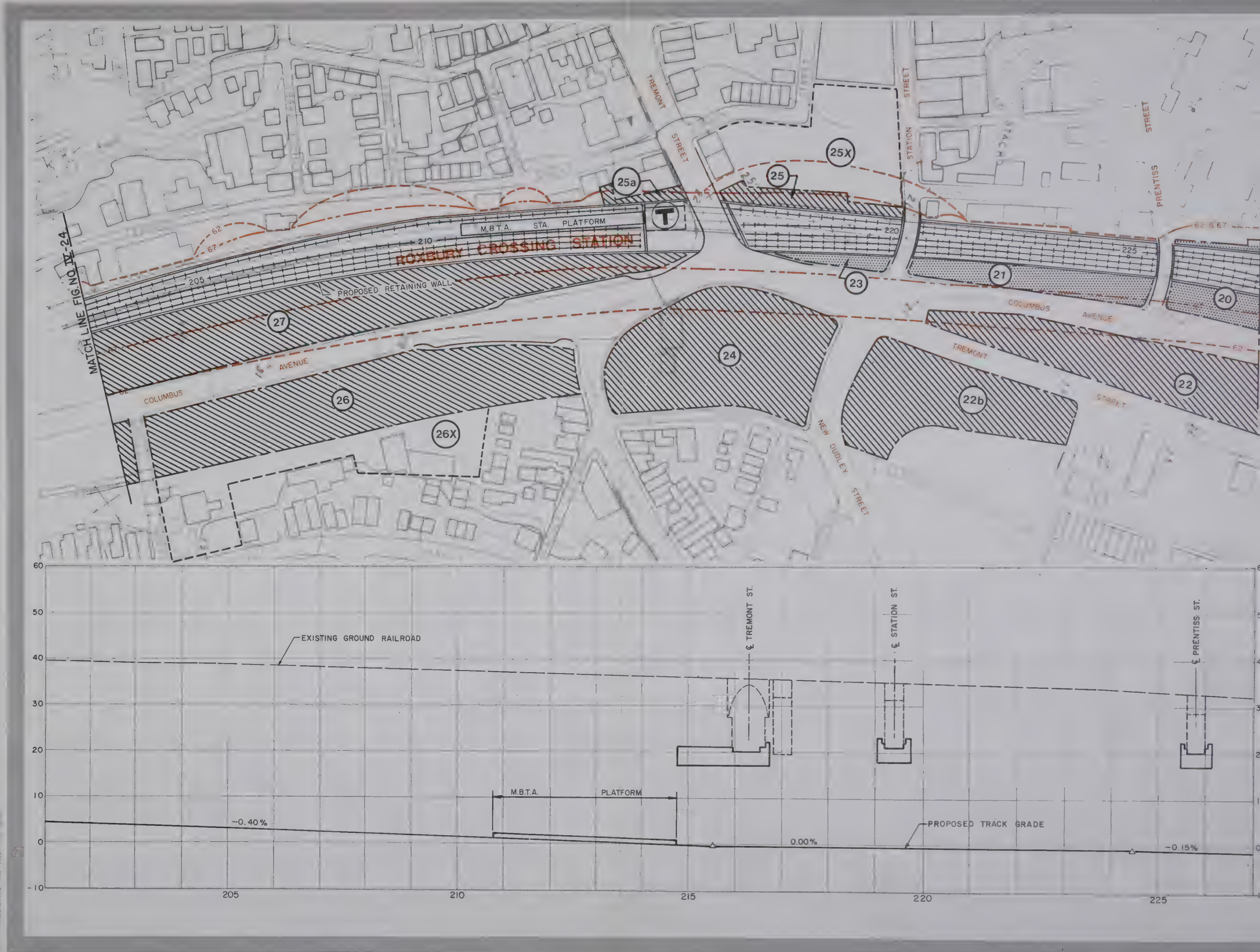
- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE

0 100 200 300

NORTH

FIGURE IV-25



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SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-1

(CAMDEN STREET to FOREST HILLS)

DEPRESSED RAIL / TRANSIT NO ARTERIAL STREET

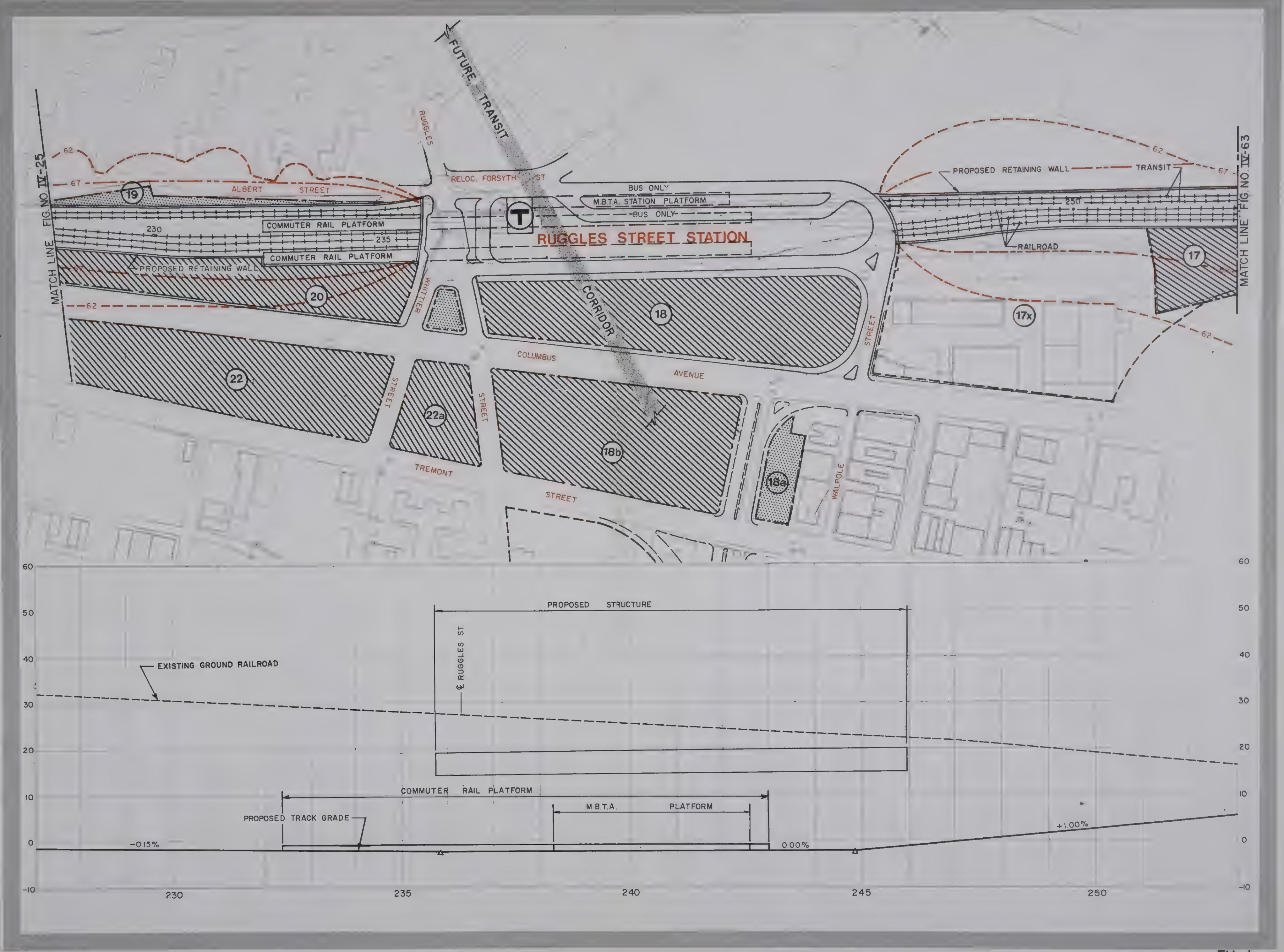
LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE

0 100 200 300

FIGURE IV-26



SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-2

(CAMDEN STREET to FOREST HILLS)

DEPRESSED RAIL / TRANSIT ARTERIAL STREET EAST

LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE

0 100 200 300

FIGURE IV-27

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-2
(CAMDEN STREET to FOREST HILLS)

DEPRESSED RAIL / TRANSIT ARTERIAL STREET EAST

LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

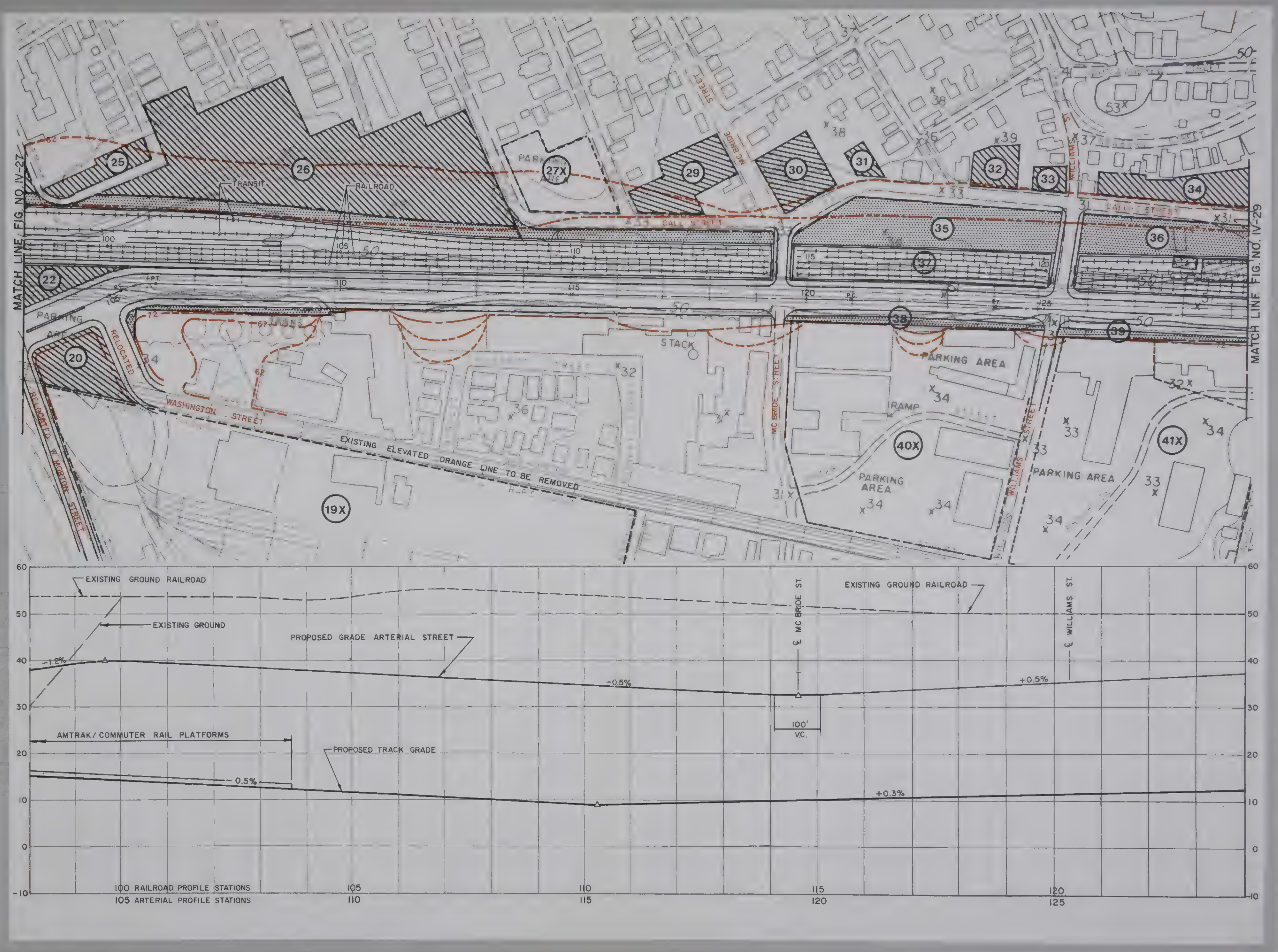
NORTH

SCALE

0 100 200 300

FIGURE

IV-28



SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-2

(CAMDEN STREET to FOREST HILLS)

DEPRESSED RAIL / TRANSIT ARTERIAL STREET EAST

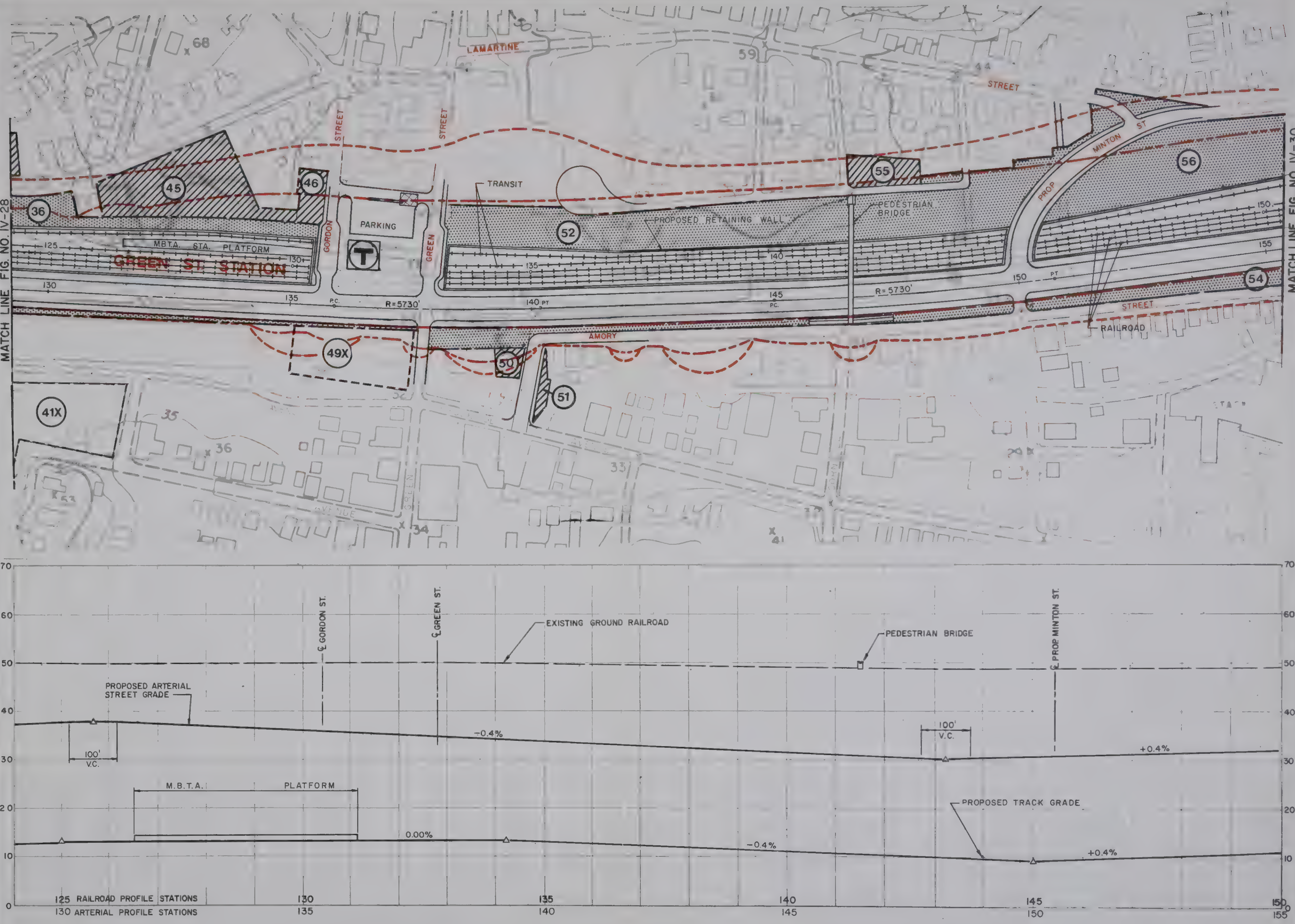
LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE

0 100 200 300

FIGURE IV-29



SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-2

(CAMDEN STREET to FOREST HILLS)

DEPRESSED RAIL / TRANSIT ARTERIAL STREET EAST

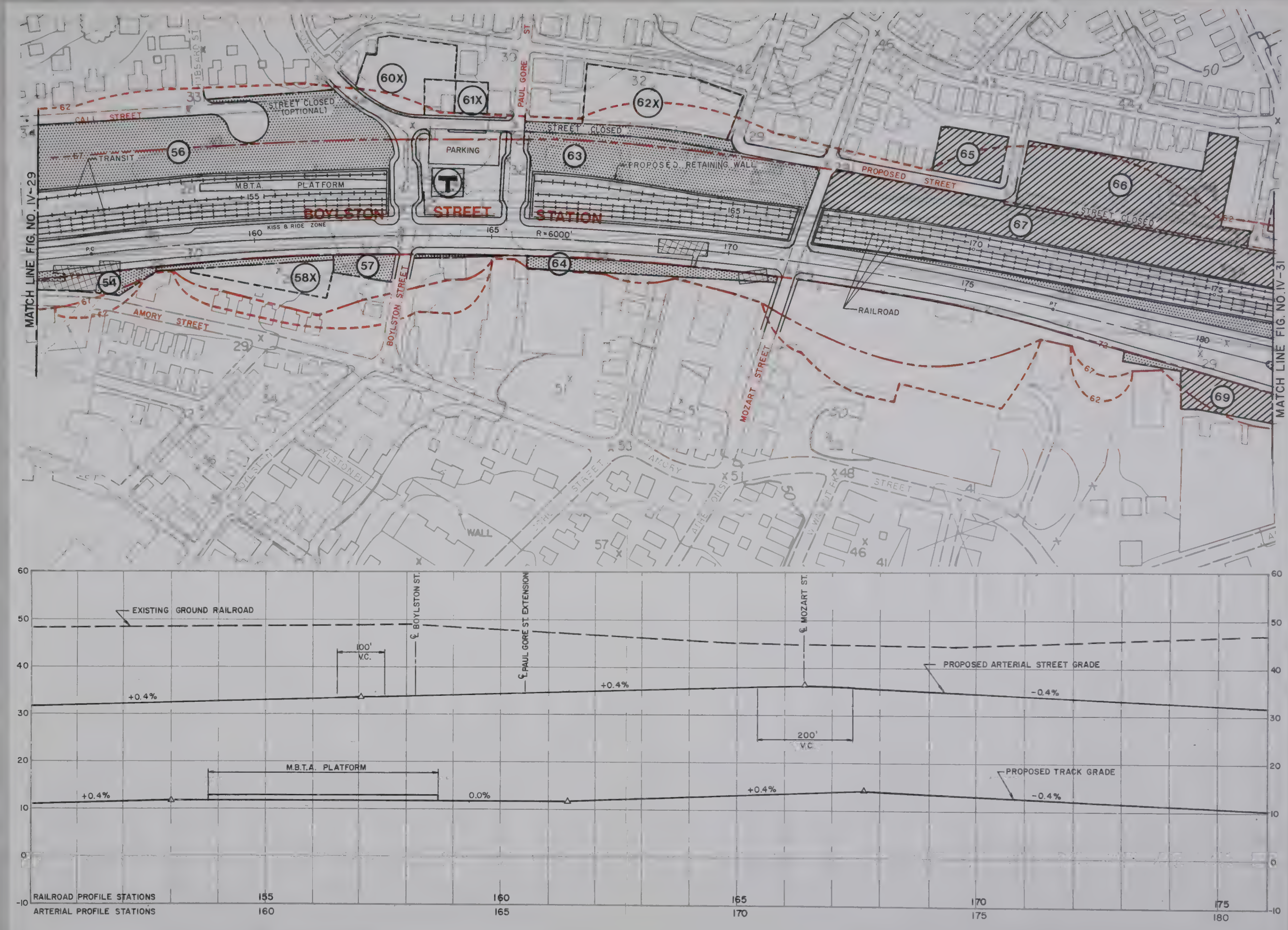
LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- (13) PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE 0 100 200 300

NORTH

FIGURE IV-30



SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-2

(CAMDEN STREET to FOREST HILLS)

DEPRESSED RAIL / TRANSIT ARTERIAL STREET EAST

LEGEND

REDEVELOPMENT PARCELS
OPEN SPACE REDEVELOPMENT
POTENTIAL REDEVELOPMENT (BY OTHERS)
BUILDINGS TO BE REMOVED
13 PARCEL NUMBER
M.B.T.A. & RAILROAD TRACK
PROPOSED STATIONS
62 NOISE CONTOUR (62 Decibels)
67 " " (67 Decibels)
72 " " (72 Decibels)

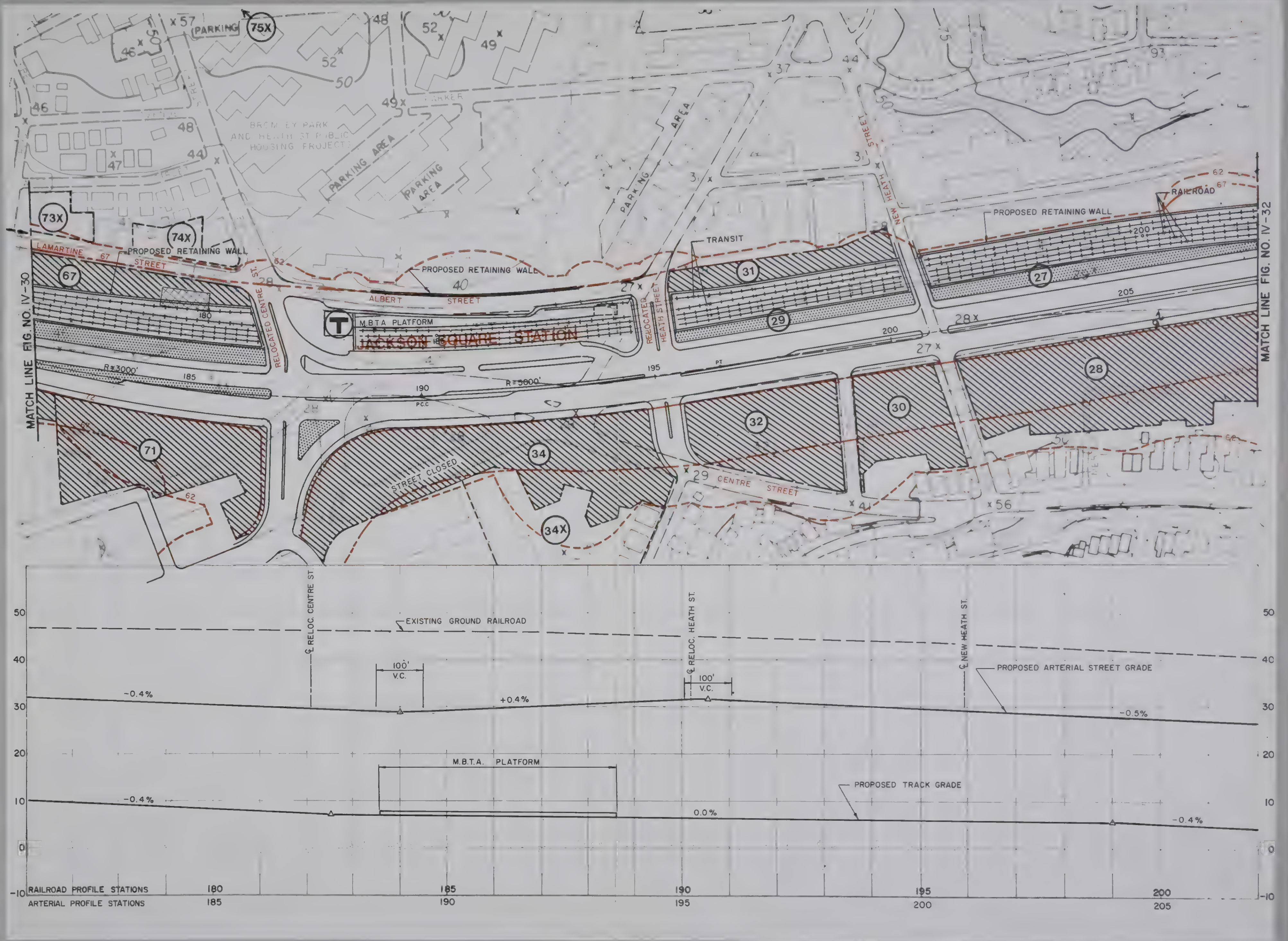
SCALE

0 100 200 300

NORTH

FIGURE

IV-31



SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-2

(CAMDEN STREET to FOREST HILLS)

DEPRESSED RAIL / TRANSIT ARTERIAL STREET EAST

LEGEND

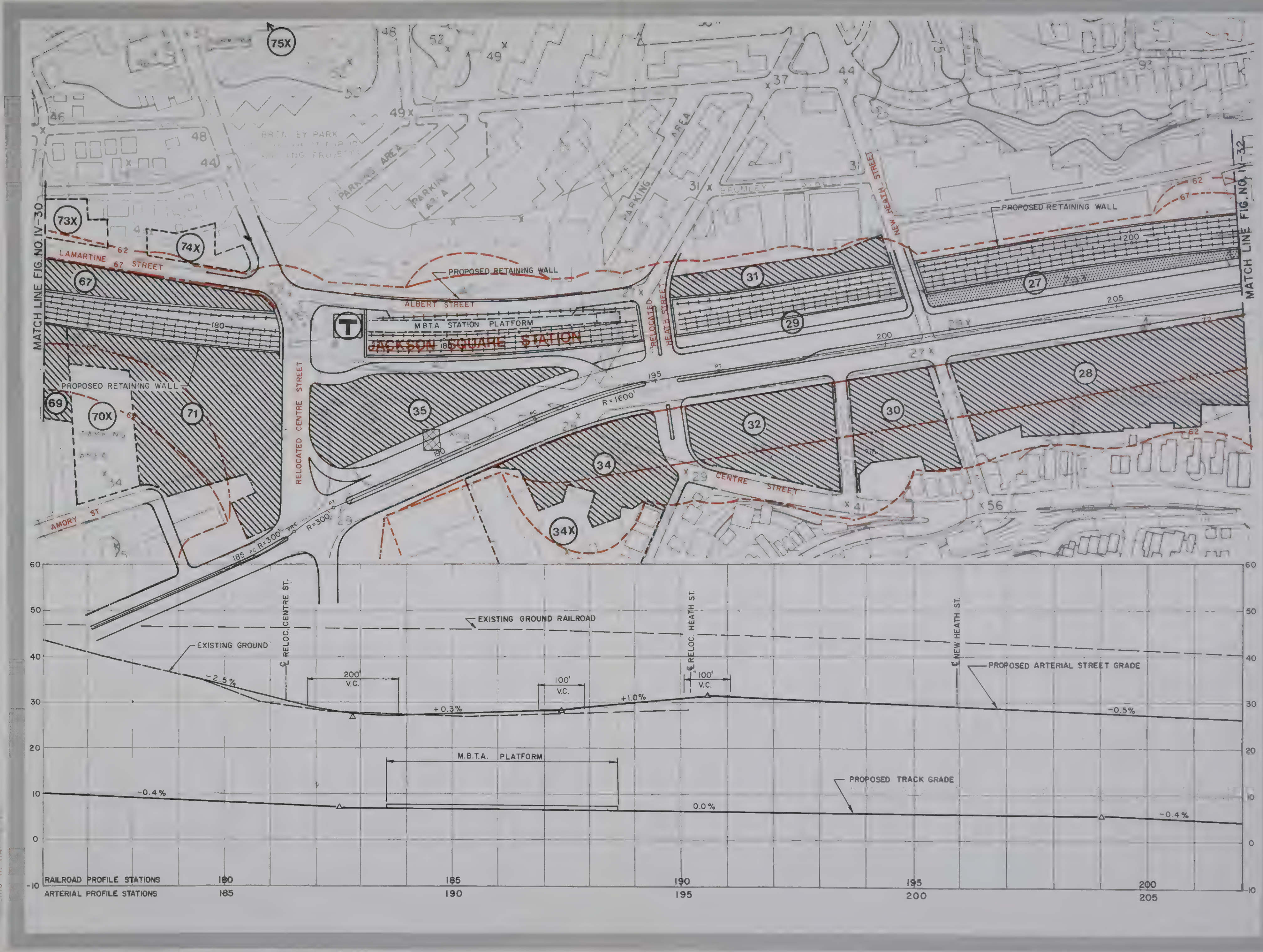
- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- T PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE

0 100 200 300

NORTH

FIGURE IV-31A



SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-2
(CAMDEN STREET to FOREST HILLS)

DEPRESSED RAIL / TRANSIT ARTERIAL STREET EAST

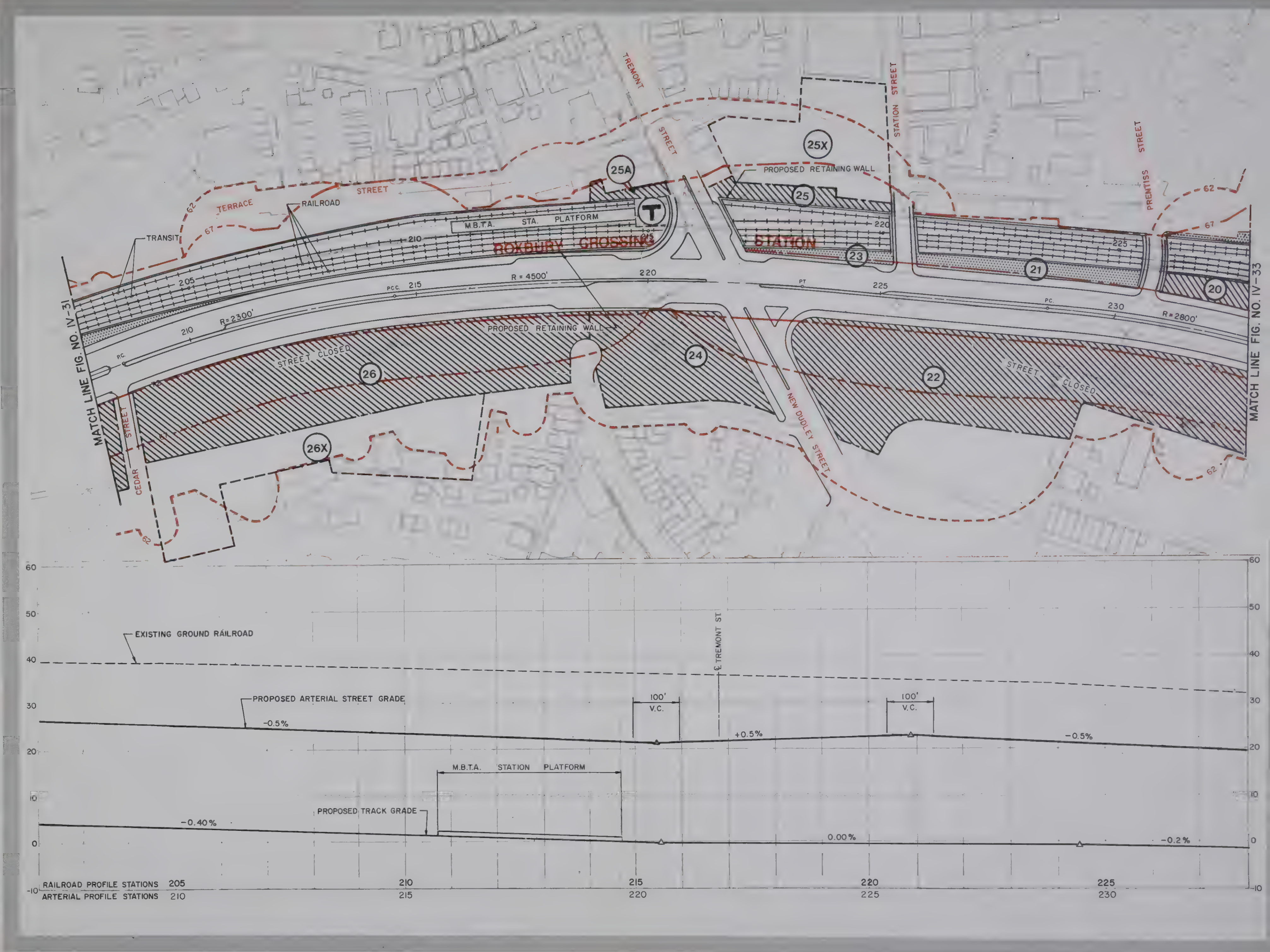
LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- (13) PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE

0 100 200 300

FIGURE IV-32



SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-2

(CAMDEN STREET to FOREST HILLS)

DEPRESSED RAIL / TRANSIT ARTERIAL STREET EAST

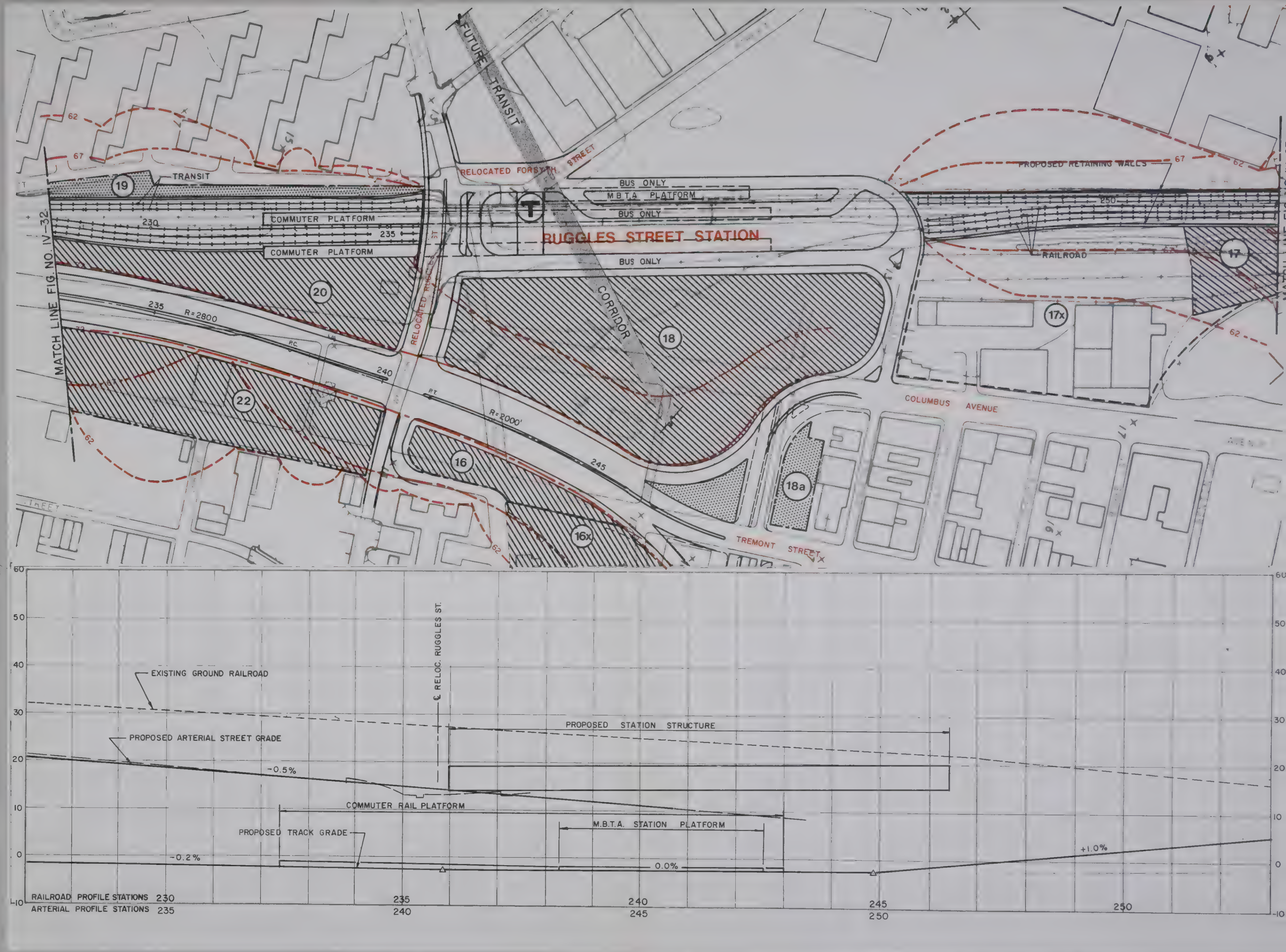
LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- (13) PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE

0 100 200 300

FIGURE IV-33



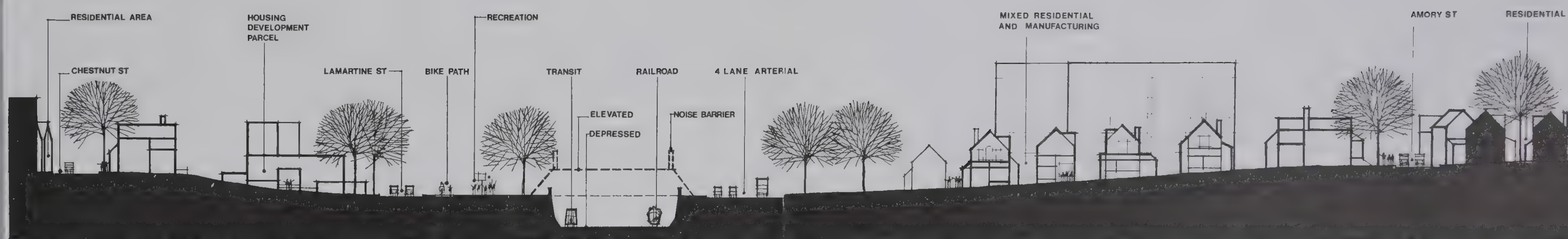
SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

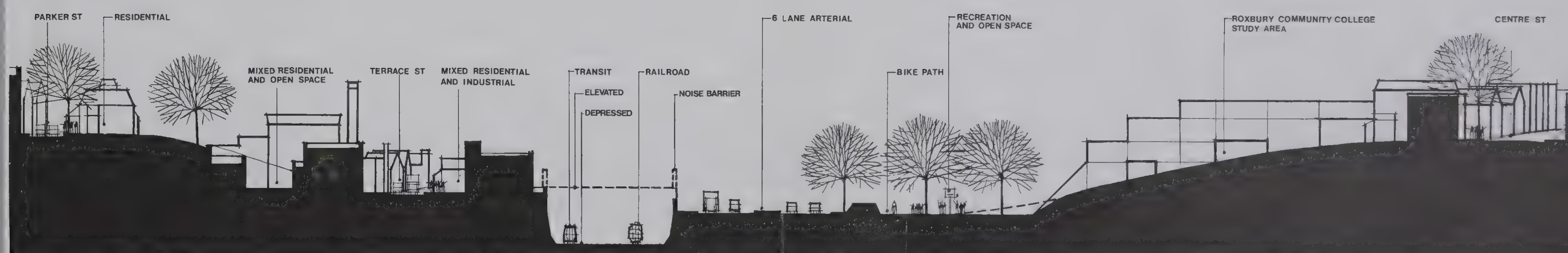
MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

ILLUSTRATIVE SECTIONS

JAMAICA PLAIN ROXBURY TRACKS DEPRESSED ARTERIAL EAST



JAMAICA PLAIN AT ATHERTON STREET FH2



ROXBURY AT CEDAR STREET FH2

SCALE

0 40 80 120

FIGURE

IV-33A

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-3
(CAMDEN STREET to FOREST HILLS)

RAIL / TRANSIT ON MODIFIED EMBANKMENT NO ARTERIAL STREET

LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- (13) PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE
NORTH
0 100 200 300

FIGURE
IV-34

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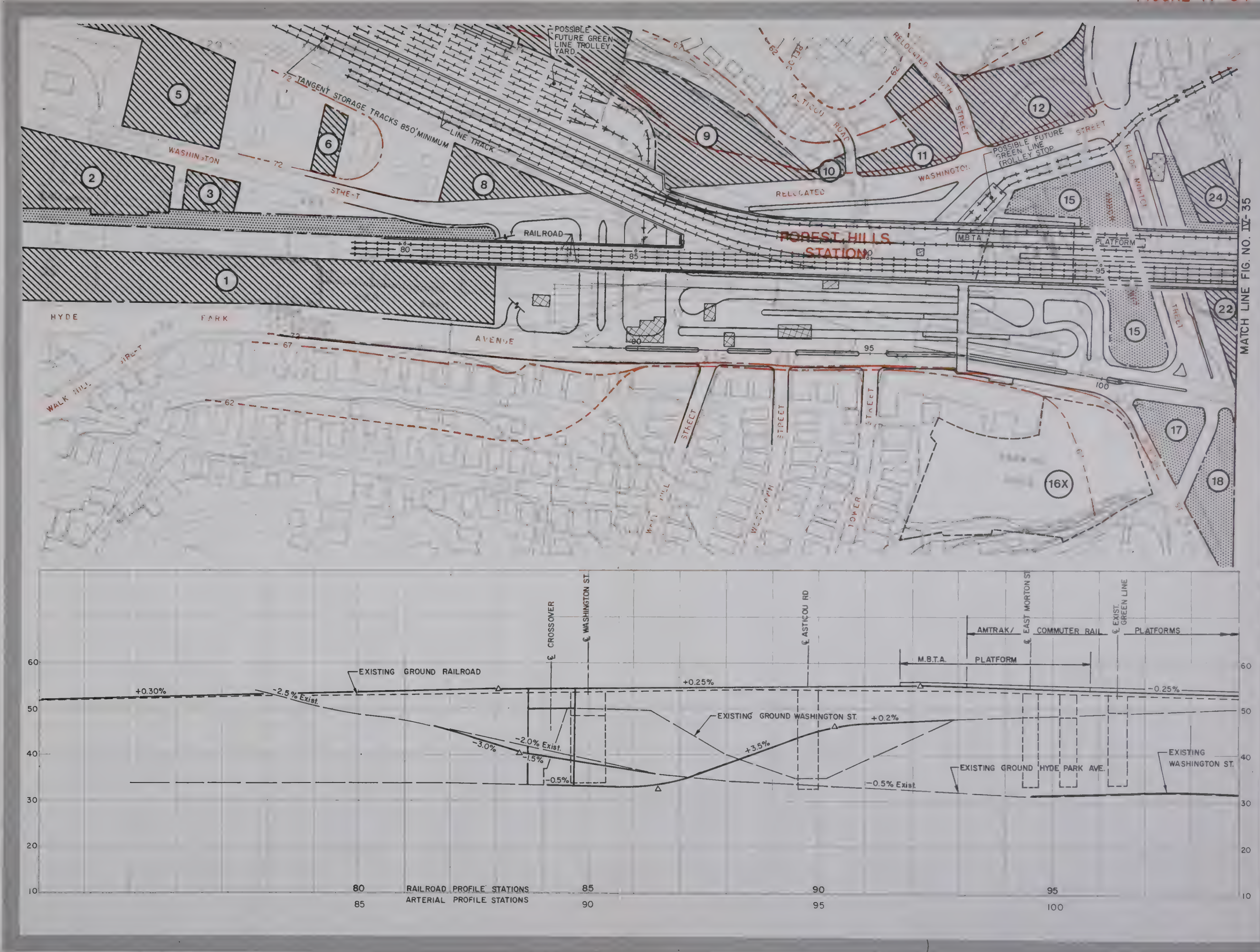


SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-3

(CAMDEN STREET to FOREST HILLS)

RAIL / TRANSIT ON MODIFIED EMBANKMENT NO ARTERIAL STREET

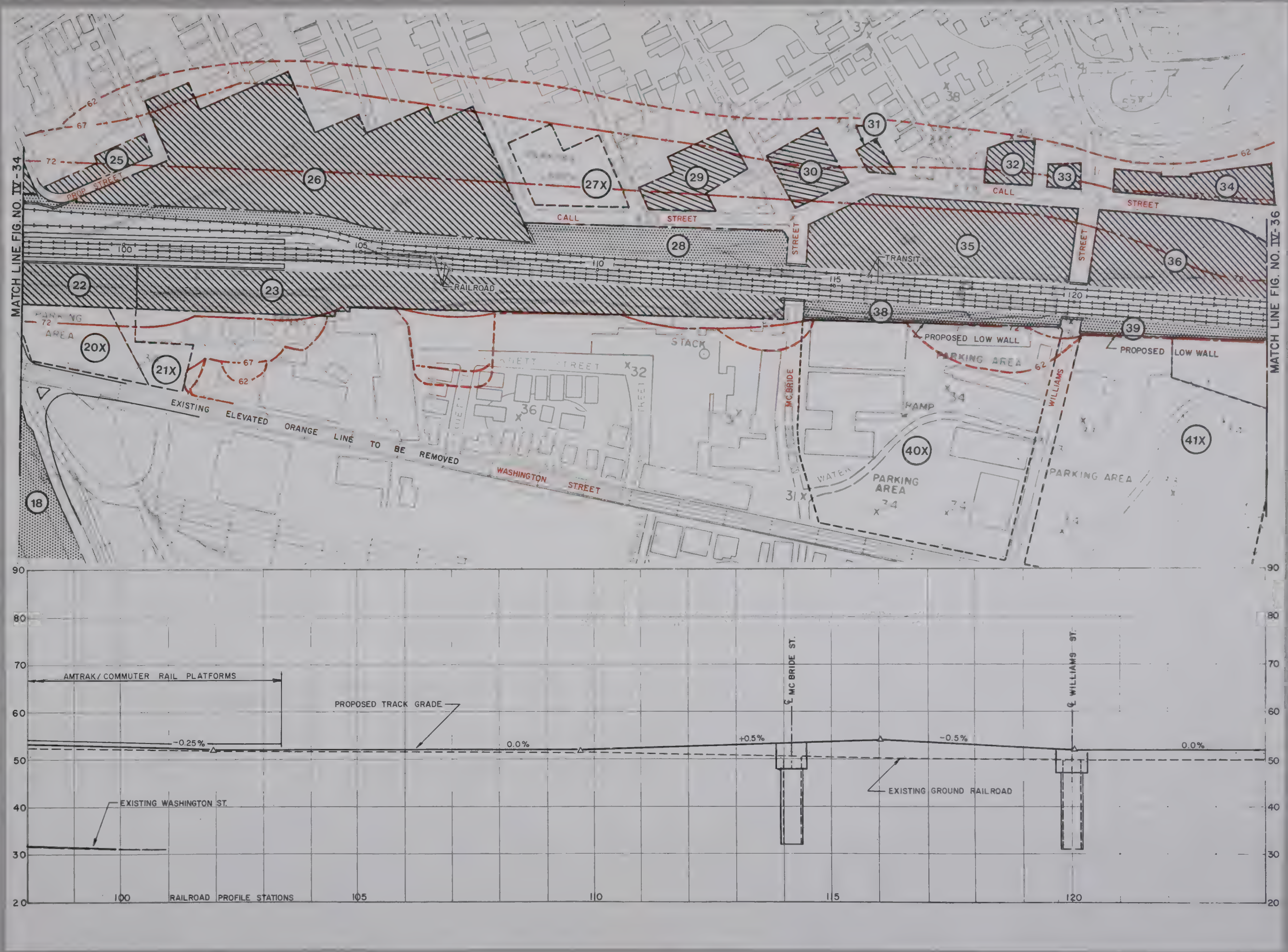
LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE

0 100 200 300

FIGURE IV-35



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SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-3

(CAMDEN STREET to FOREST HILLS)

RAIL / TRANSIT ON MODIFIED EMBANKMENT NO ARTERIAL STREET

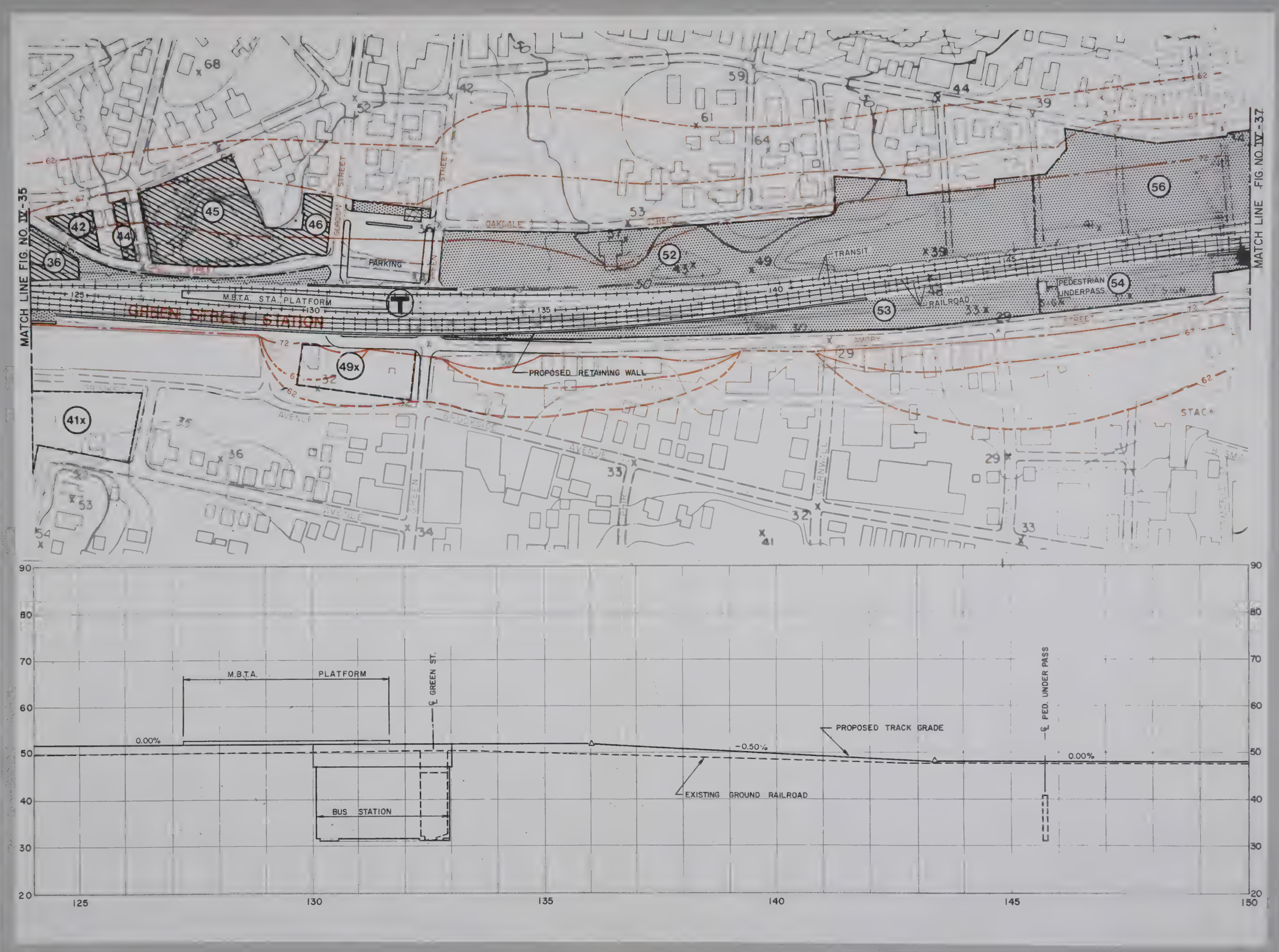
LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE

0 100 200 300

FIGURE IV-36



SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-3

(CAMDEN STREET to FOREST HILLS)

RAIL / TRANSIT ON MODIFIED EMBANKMENT NO ARTERIAL STREET

LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

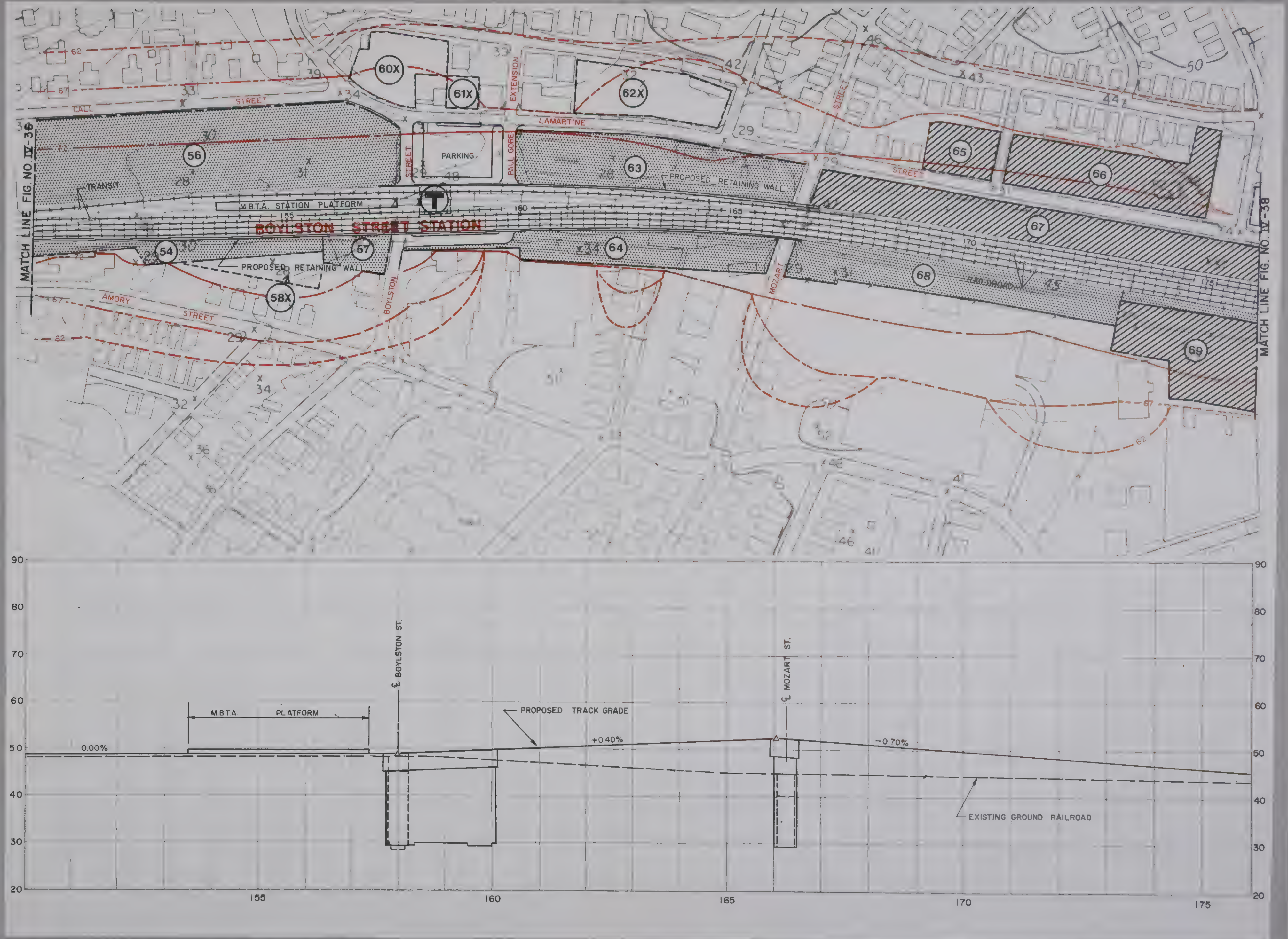
NORTH

SCALE

0 100 200 300

FIGURE

IV-37



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SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-3
(CAMDEN STREET to FOREST HILLS)

RAIL / TRANSIT ON MODIFIED EMBANKMENT NO ARTERIAL STREET

LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- (13) PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE
0 100 200 300

NORTH

FIGURE IV-38

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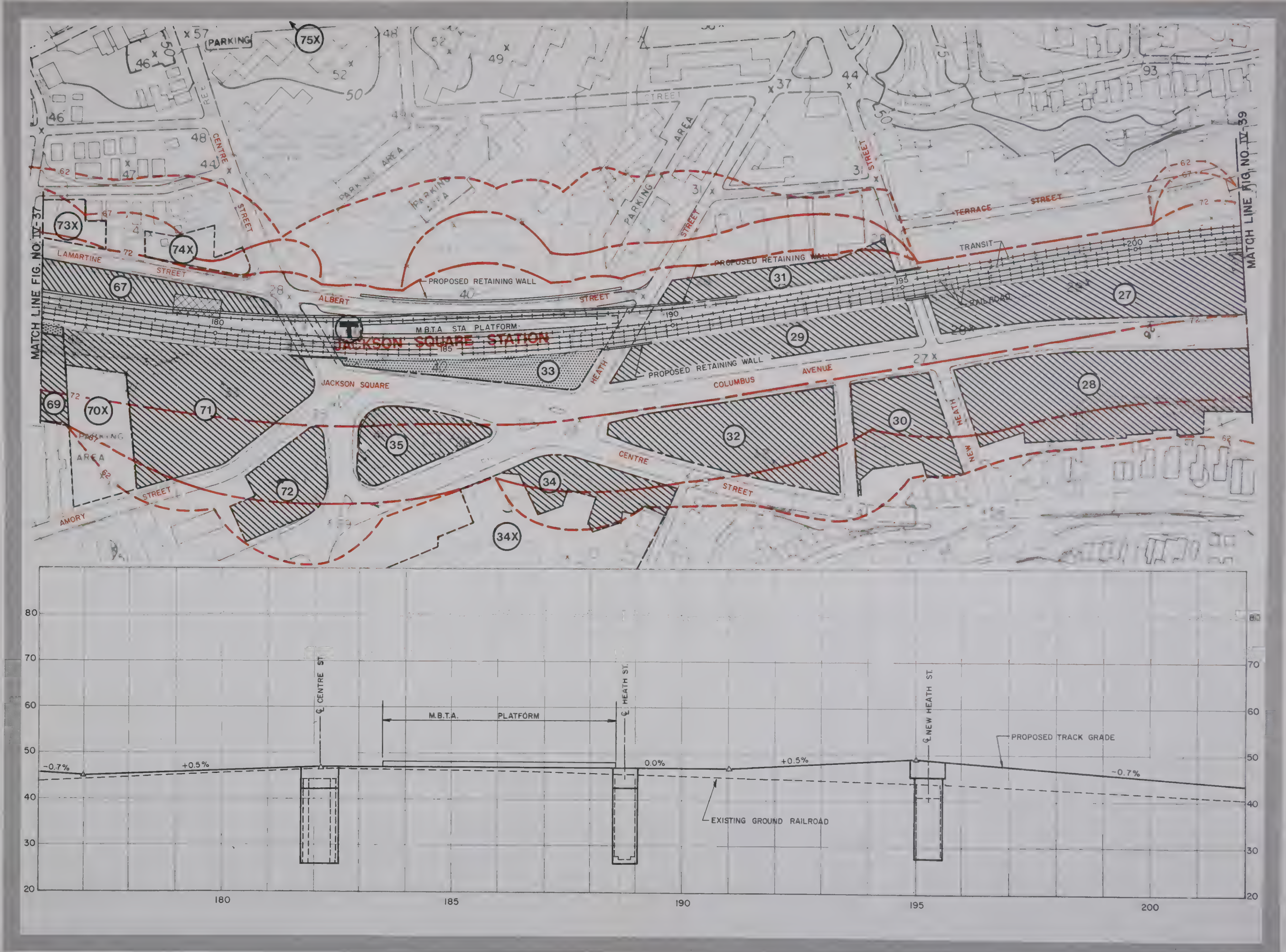

SOUTHWEST CORRIDOR TRANSPORTATION IMPROVEMENTS

ENVIRONMENTAL IMPACT ANALYSIS

MASSACHUSETTS BAY TRANSPORTATION AUTHORITY
MASSACHUSETTS DEPARTMENT OF PUBLIC WORKS

PLAN & PROFILE

ALTERNATIVE FH-3
(CAMDEN STREET to FOREST HILLS)

RAIL / TRANSIT ON MODIFIED EMBANKMENT NO ARTERIAL STREET

LEGEND

- REDEVELOPMENT PARCELS
- OPEN SPACE REDEVELOPMENT
- POTENTIAL REDEVELOPMENT (BY OTHERS)
- BUILDINGS TO BE REMOVED
- 13 PARCEL NUMBER
- M.B.T.A. & RAILROAD TRACK
- PROPOSED STATIONS
- 62 NOISE CONTOUR (62 Decibels)
- 67 " " (67 Decibels)
- 72 " " (72 Decibels)

SCALE
0 100 200 300

FIGURE IV-39